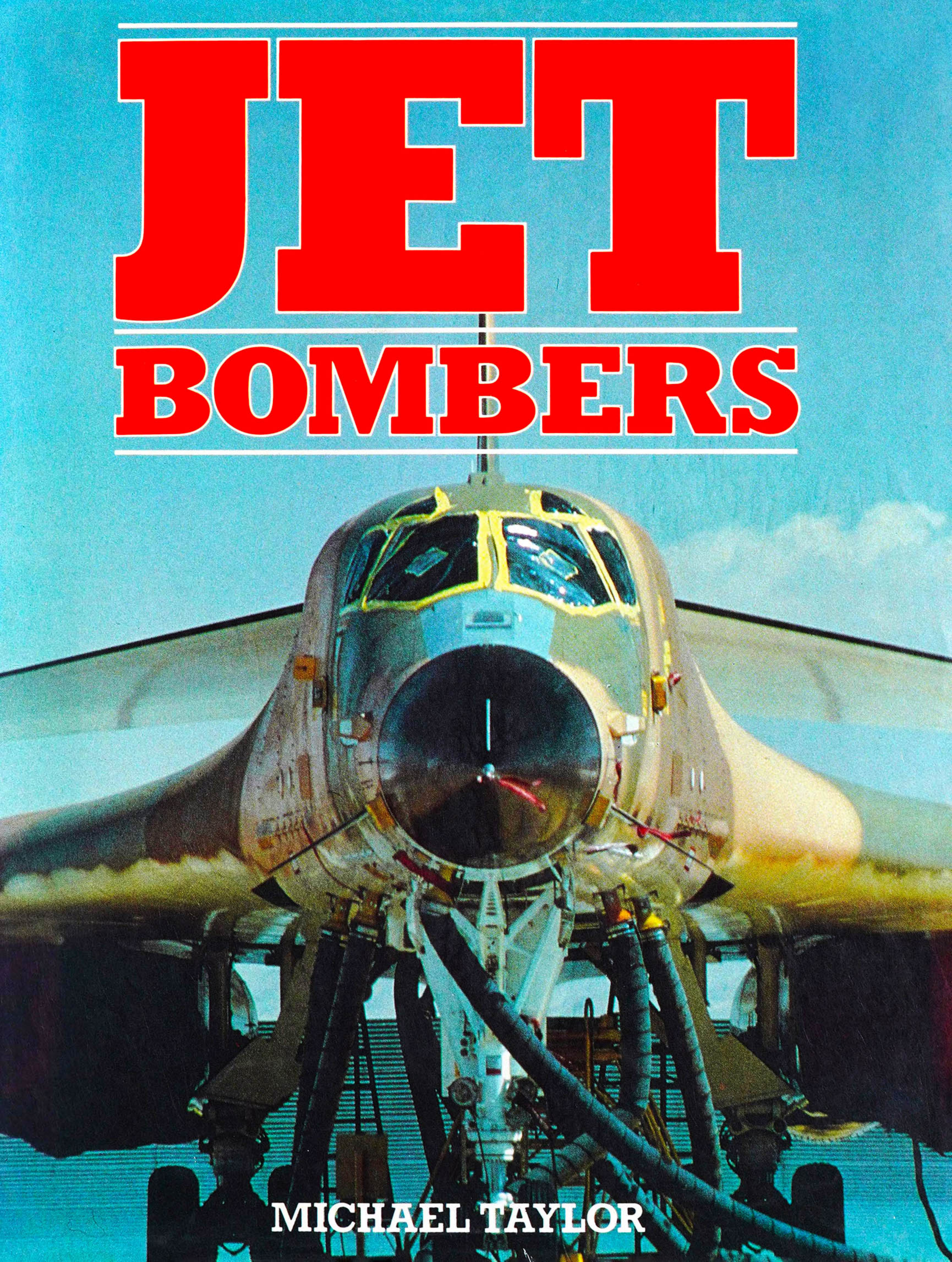
JET BOMBERS



MICHAEL TAYLOR

$25.00

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Since its operational debut towards the end of World War II the jet bomber has hit the world's headlines. The Arado Blitz bomber was one of the Luftwaffe's wonder weapons, which was expected to turn the tide of war in Germany's favor at the eleventh hour. The Allies had nothing to match it and it was not until the early 1950s that jet bombers began to appear in the NATO air forces. The USAF's Strategic Air Command introduced the six-jet B-47 Stratojet, which threatened the Soviet Union with nuclear devastation in the successive crises over Berlin, Suez and Hungary during the 1950s.

When the world again stood of the brink of war during the Cuba Missile Crisis in 1962, it was SAC's giant B-52 Strato-fortresses which were placed on alert. By this time the Soviet Union too had its intercontinental bombers - Tupolev Bears and Myasischev Bisons - ready to fly over the top of the world to release their thermonuclear weapons on American cities. Today the jet bomber is still a warplane to be reckoned with, as American strategists anxiously ponder on the threat posed by Backfire, while their Soviet counterparts apprehensively await the introduction of the USAF's potent new B-1B.

The history of these apocalyptic weapons is related by Michael Taylor, an outstanding aircraft historian and contributor to the prestigious *Jane's All the World's Aircraft*. His writing is complemented by numerous full color photographs, many of them rare and previously unpublished. The combination of text and pictures makes *Jet Bombers* a a book which no aircraft buff will be able to resist.

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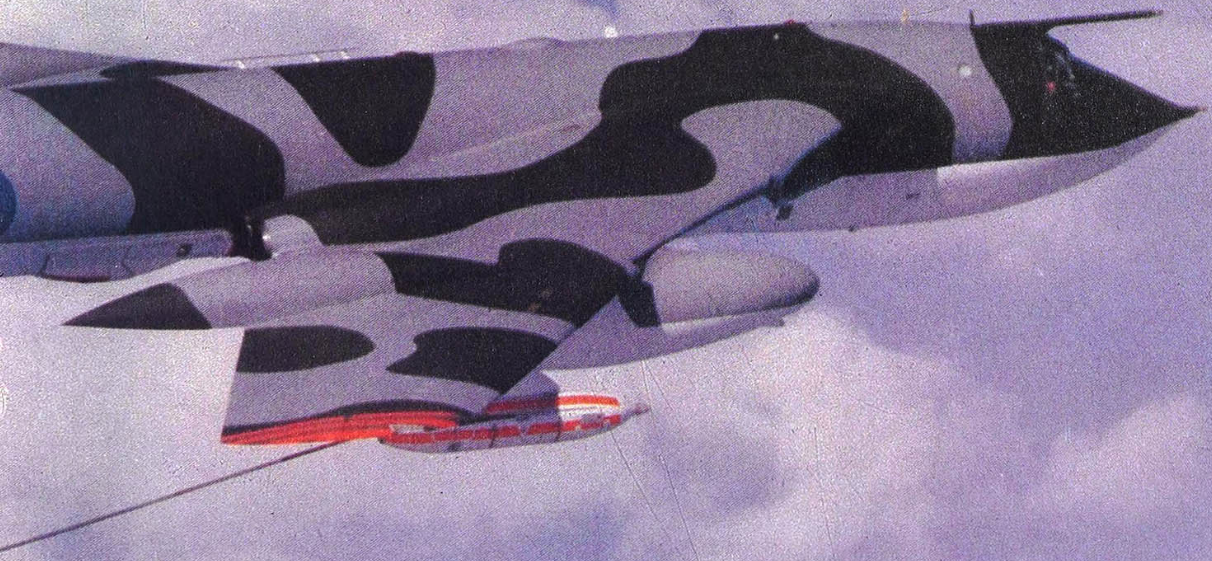

BISON BOOKS

First Published in 1983 by
Bison Books Corp.
17 Sherwood Place
Greenwich, CT 06830
USA.

ISBN 0 86124 122 3

Printed in Hong Kong

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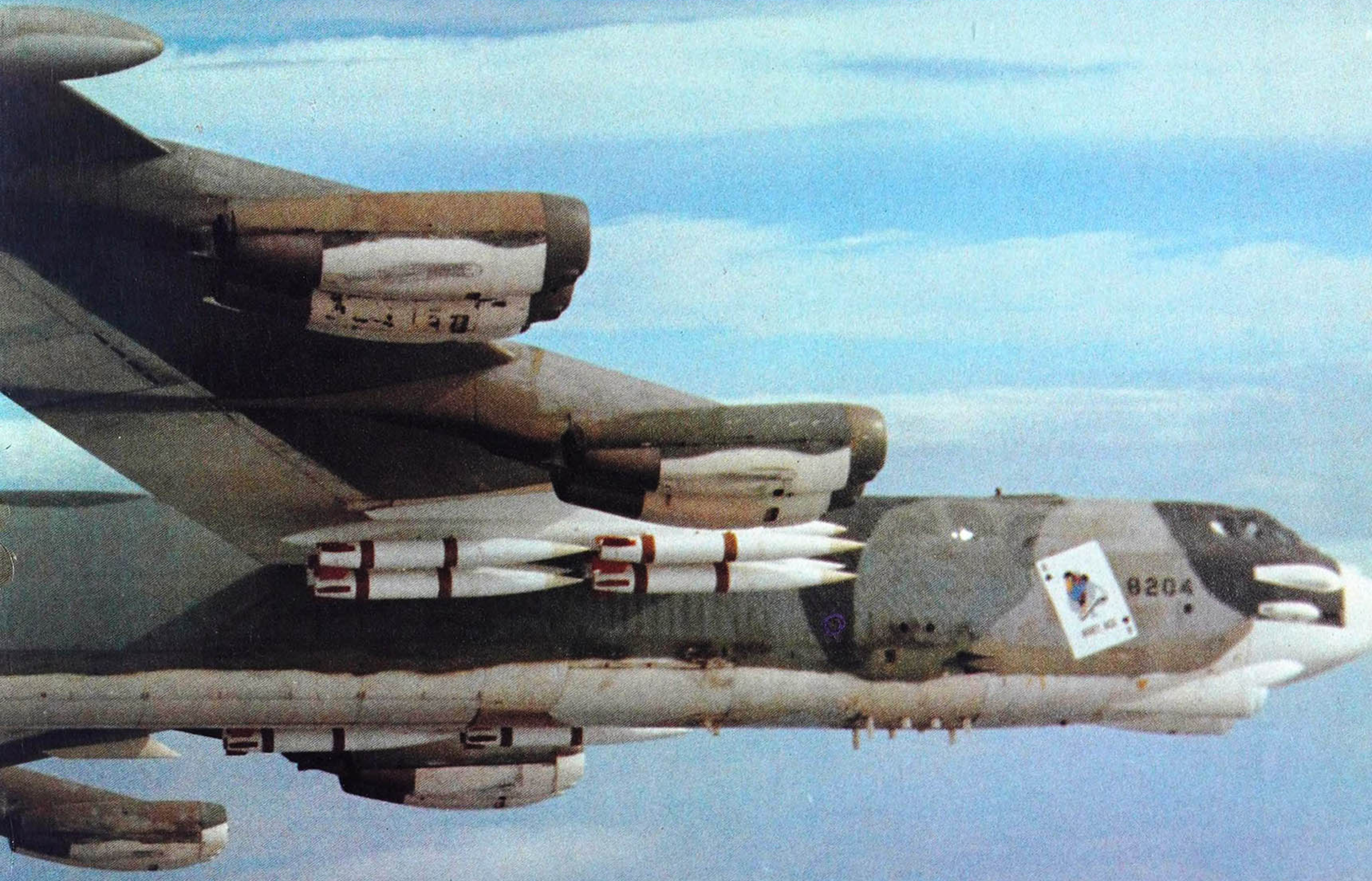

INTRODUCTION

Jet Bombers is a follow-up book to the successful *Jet Fighters*, using a similar format to describe and illustrate the gradual development of jet bombers from the earliest German types of World War II to the latest offerings of the 1980s.

It is not the author's intention to mirror the opening chapter of Jet Fighters, which relates to the development of turbojet engines. Instead, and because jet bombers followed jet fighters into service, only a brief summary of engine development is considered necessary. Also, a chapter has been devoted to bomb- and missile-carrying attack aircraft in current use around the world. These aircraft, smaller and lighter than strategic and tactical bombers, are the modern-day equivalents of the Airco (de Havilland) D.H.4, Douglas Havoc, Ilyushin Il-2 Shturmovik and similar piston-engined types of yesteryear.

As with *Jet Fighters*, the majority of the illustrations in this book are full color. However, monochrome photographs have been included where no color has become available. By adopting this approach, photographs of several very rare aircraft have been included to enhance the book.

From Blitz to Blackjack, prototypes to production aircraft, *Jet Bombers* offers the reader an insight into the jet-powered aircraft built for combat since 1943.

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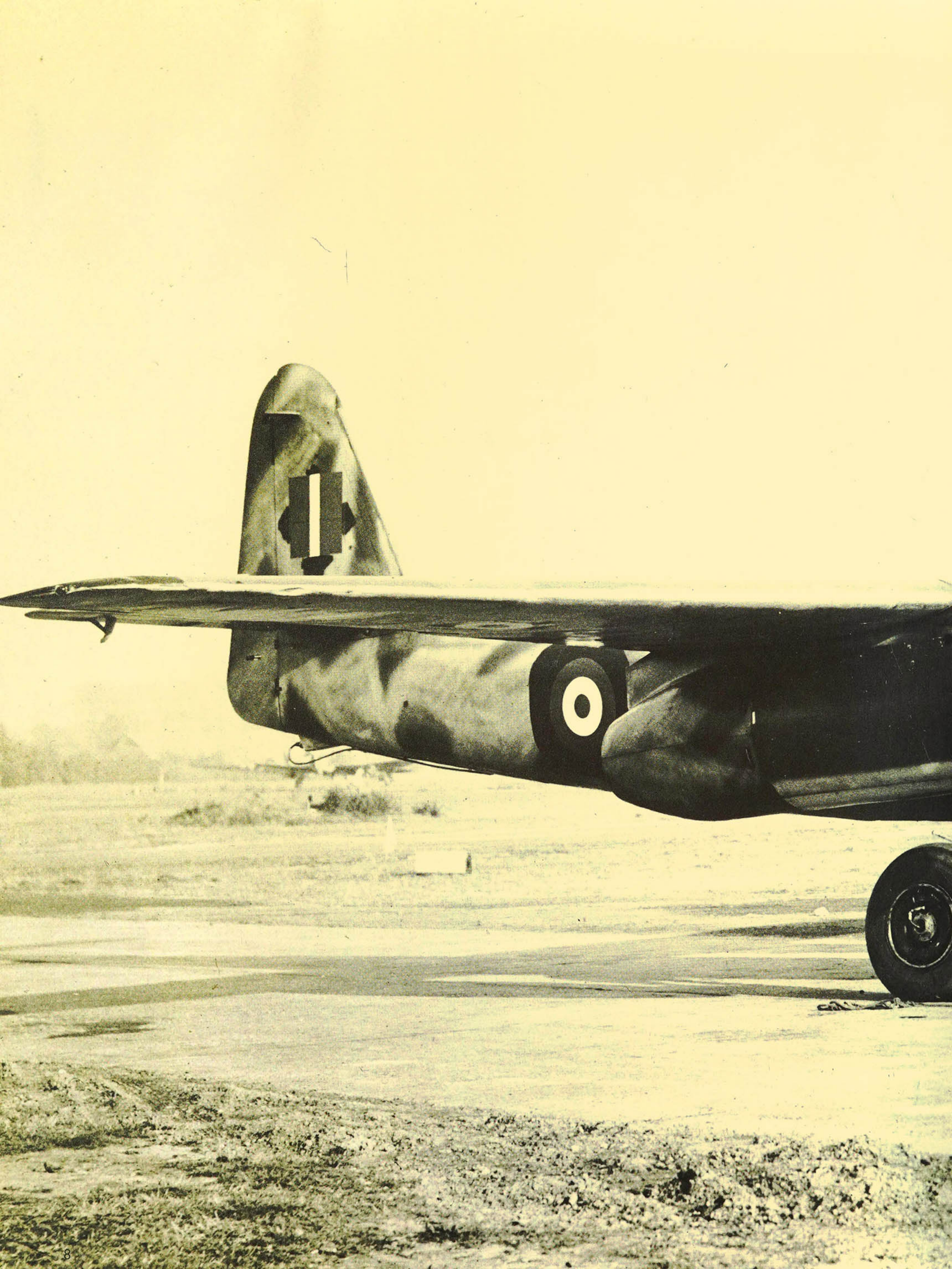
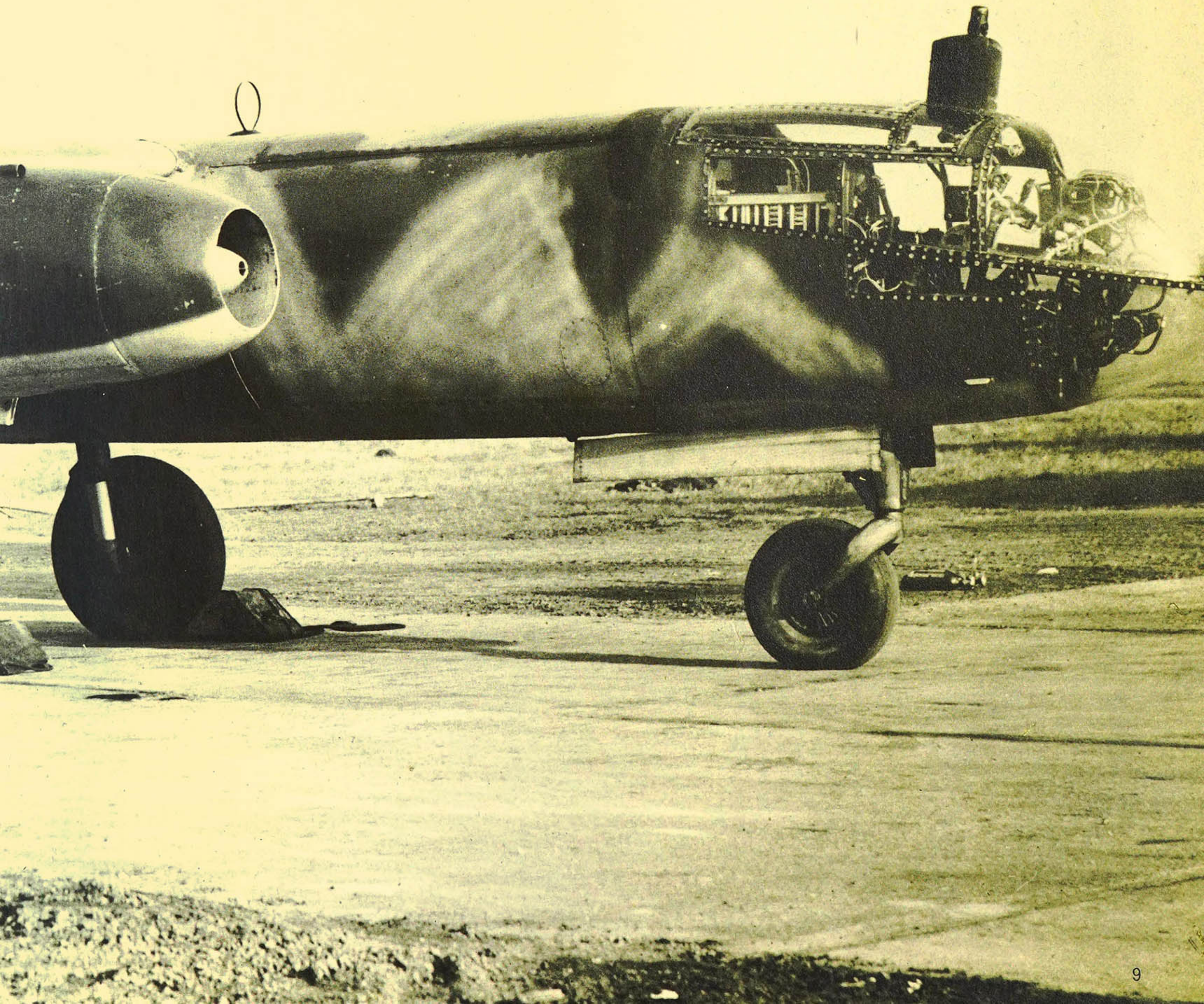


1: A FLASH OF LIGHTNING



Toward the end of World War II a typical heavy bomber carried perhaps 6350kg (14,000lb) of bombs at a speed usually not exceeding 480km/h (300mph). It was not uncommon for about 1000 bombers of various types to be used on a single raid, leaving massive devastation as never seen before and climaxed only by the atomic bombs dropped on Hiroshima and Nagasaki in August 1945. Yet in the 1980s a single-seat, lightweight air combat fighter of General Dynamics F-16 Fighting Falcon caliber can itself carry a warload of up to 9276kg (20,450lb) in a secondary attack role. To confuse issues further, Fairchild Republic A-10A Thunderbolt II close-support aircraft in service with the USAF are deployed by what are called Tactical Fighter Wings, yet the A-10 has provision for virtually every form of ground attack weapon but no air-to-air armament.

The meaning of the term 'bomber' has become confused over the years and nowadays is often used only when referring to strategic bombers deployed to deliver an attack on selected targets within the enemy's territory. However, it can be assumed that there are two other categories of 'bomber' before encompassing multi-role combat aircraft of primary fighter design and fighter-bombers. These are tactical bombers and attack aircraft. Tactical operations are against opposing enemy forces within a limited area, and this can be within or outside the territory of the attacked or the aggressor. Attack is more general and can also cover other terms such as ground support and interdiction. It is normally accepted to mean a mission against a specific tactical surface target or on a target behind enemy lines. It is within the framework of strategic, tactical and attack that this book is based, stopping short of heavily-laden air combat fighters and fighter-bombers.

It is a curious fact, or perhaps more correctly a financial dictate, that the world's air forces have fewer strategic bombers in service today than at any time since World War I. It is true that the awsome capabilities of modern aircraft coupled with the incredible destructive power of the latest missiles and bombs make individual bombers of today far more formidable than a squadron from past decades, yet this is not the whole picture. The Royal Air Force, for example, with a tradition of strategic bombing capability that originated as long ago as 1917 with the formation of the 41st Wing (then correctly part of the Royal Flying Corps) to bomb strategic industrial targets in Germany, is on the verge of having no bomber capable of a long-range strategic mission. Yet it was the Vulcan, earmarked for the scrapyard, that was instantly reprieved for service in the South Atlantic in 1982. Similarly, NATO as a whole relies on the USAF's ageing Boeing B-52 Stratofortress as its only heavy long-range bomber, its capabilities continuously enhanced by the addition of advanced systems and new missiles. The Soviet Union, with its own tradition of a large strategic bomber force dating from the 1920s, is the only nation currently developing and deploying strategic bombers as part of a continuous program.

It is a matter of history that the last sortie over Britain by the Luftwaffe during World War II was flown by an Arado Ar 234B Blitz (Lightning) reconnaissance aircraft from KG 76. The Blitz, however, is best remembered as the world's first turbojet-powered bomber in its Ar 234B-2 version and Germany's second jet in military service.

It all began on 27 August 1939 when Germany flew the first ever turbojet-powered airplane, the diminutive Heinkel He 178. In fact virtually all of the credit for achieving this honor was due to just two men, Ernst Heinkel, head of the aircraft manufacturing company bearing his name, and Hans Joachim Pabst von Ohain who conceived the engine upon which it flew. But in 1937 Junkers had begun development of its own turbojet engine, encouraged by the technical division of the Reichsluftfahrtministerium (RLM), the German aviation ministry. The outcome was the Jumo 109-004, first started up in November 1940. Despite Heinkel's early lead with turbojet engines, it was upon the Junkers turbojet and the favored rival, the BMW 109-003 which also first ran in 1940, that the RLM based a 1940 specification for a twin-engined high-speed reconnaissance aircraft. It is fact, therefore, that in the year before Britain flew its first turbojet-powered aircraft, Germany actually planned operational types.

During the next months Dipl Ing Walter Blume and Ing Hans Rebeski of the Arado Flugzeugwerke GmbH made several preliminary design studies for the aircraft, which was expected to fly into enemy airspace with impunity by virtue of a high operating altitude coupled with high speed. And who could fault the logic. Since the latter half of 1940 specially-prepared

Previous page: Captured Arado Ar 234B *Blitz* in Allied markings.

A General Dynamics F-16A Fighting Falcon dropping a bombload similar in weight to that carried by many heavy bombers of World War II.

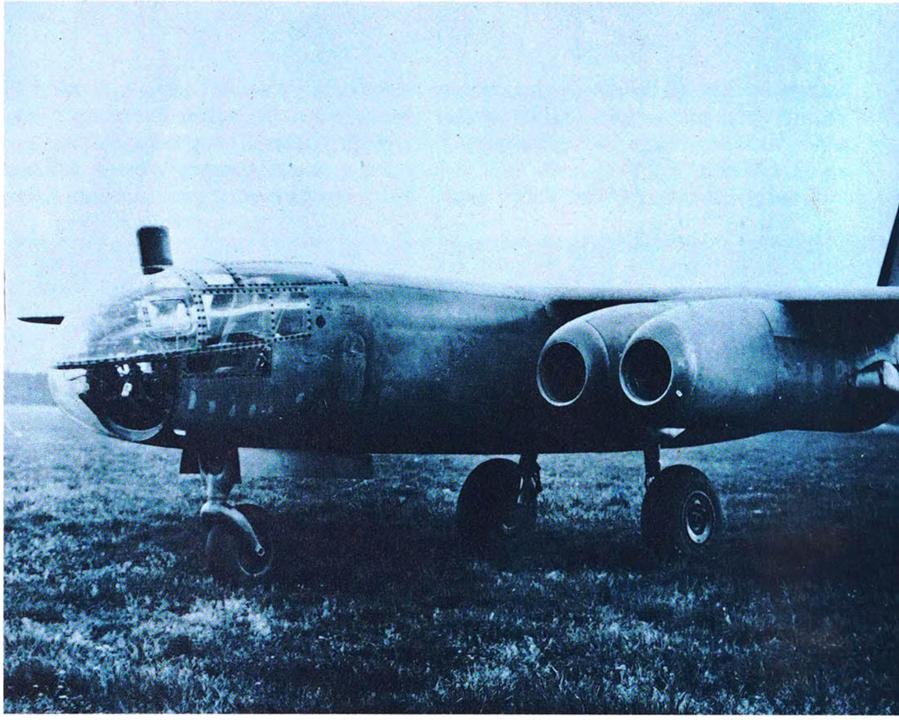
Junkers Ju 86P high-flying reconnaissance aircraft, with pressurized cabins for the crews, had flown missions over Britain without interception.

In early 1941 proposal E.370 was accepted by the RLM and the Arado Ar 234, later named Blitz (Lightning), germinated. In fact the airframe was conventional considering the pioneering concept. The turbojet engines were carried beneath the high-mounted (often quoted as shoulder-mounted) tapering wings, which had flush riveted stressed skins. Very narrow-chord Frise-type ailerons with mass-balanced geared tabs were fitted on the inboard sec-

tions, and hydraulically-actuated flaps were positioned each side of the turbojet nacelles. The semi-monocoque circular-section fuselage also had flush-riveted stressed skins, and it was the narrowness of this, coupled with wing position, that gave rise to the aircraft's most unusual feature.

It is probably true to say that the Ar 234 owed some of its design features to the Ar 232, a general-purpose transport conceived to a 1939 specification. This had the pilot's cockpit in the extreme nose of the fuselage (although in the Ar 234's case the cockpit was expected to be pressurized), high-mounted wings, and a unique undercarriage arrangement that included eleven pairs of small wheels in tandem under the fuselage, a large nosewheel and long legs for the mainwheels under the engines. This rather strange arrangement resulted from the need to produce a strong undercarriage, but one which was sufficiently low to allow freight to be loaded directly from trucks and which would not restrict freight-carrying room inside the fuselage when the main wheels were retracted. The Ar 234 presented the designers with similar problems, as a retractable undercarriage had to be devised that would not be effected by the narrowness of the fuselage nor the height or thinness of the wings. There appeared but few solutions. One, which must have been inspired by the Ar 232, was to adopt a large number of small retractable wheels in tandem beneath the fuselage and stabilizing skids on outriggers beneath the engine nacelles and retracting into them. In the event, the RLM decided upon the concept of using a jettisonable take-off trolley, leaving the aircraft to land on an underfuselage main skid and the under-nacelle skids. Interestingly, this system of take-off and landing was not unique to the Blitz and even found favor after the war in France when that country developed an experimental tactical fighter that could operate independently of airfields with long runways.

In operation, the Ar 234 was to be mounted on a non-powered tricycle trolley, which had a steerable nosewheel and pilot-operated brakes. At the moment of lift off, the trolley was to jettison, a braking parachute stopping it from careering to destruction and so allowing reuse. Apart from the obvious restrictions of airfield clearance once Ar 234s had landed, as the stranded aircraft would need to be lifted and towed away, this system appeared to be the answer, especially as it gave the added bonus of reducing the aircraft's all-up weight.



V13 configured as an Ar 234C-type prototype with paired engines.

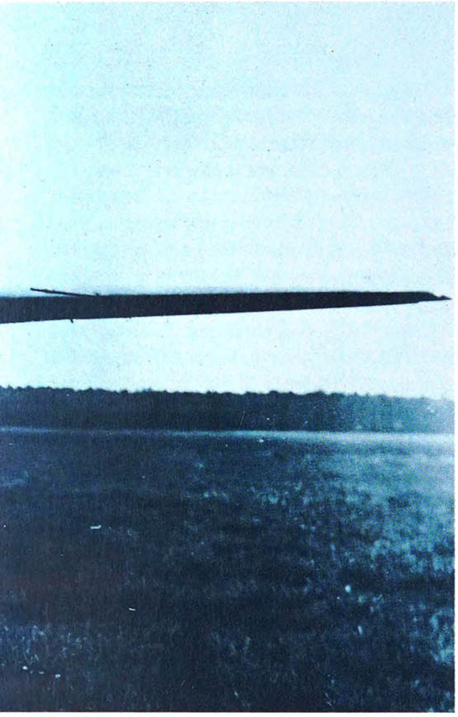
Prototype construction began in early 1941 but a cruel blow lay in store. By late 1941 the first prototypes were nearing completion but there had been no delivery of engines to power them. Indeed, the Junkers Jumo 109-004 development program was well behind schedule and Messerschmitt had priority for delivery of early 004s from the factory for its fighter. Further, BMW was obtaining thrust ratings well below those expected from its 109-003 turbojet. In reality, by this time the Jumo 109-004 had only just been flown experimentally by a Messerschmitt Bf 110 and modifications were then in hand to produce the improved 004B as a follow-up engine to the intial 004A.

Although Messerschmitt was in the same boat when it came to prepared airframes for its first jet aircraft but no engines, at least that company had managed to get its Me 262 off the ground on the power of a nose-mounted piston engine. The Ar 234 was unable to do this, as the skids on which it would land provided too little ground clearance for propellers. Arado was forced to recognize that flight testing could not begin until Jumo 109-004As arrived.

Hopeful signs came in July 1942, when a prototype Me 262 was flown on the power of Jumo 109-004As. Surely Arado need not wait much longer. In fact Arado had to wait another seven months for a delivery from Junkers and, as fighters and fighter-bombers had priority, the only two engines then received were not cleared for flight. At least ground testing could now begin and with these installed Ar 234 V1 undertook taxying trials using the trolley arrangement. Progress was now rapid. Two months later, in May, this aircraft was sent to Rheine airfield where two new flight-cleared Junkers turbojets were installed. So as not to take any chances with the prototype, it was decided that the take-off trolley should not be jettisoned at lift-off but carried to an altitude of approximately 60m (195ft), at which height it would be released to descend on parachutes.

On 15 June 1943, almost eleven months after an Me 262 prototype had flown on 004As, the first Ar 234 prototype took to the air with Flugkapitän Selle in the pilot's seat. Later in the development program Selle was to lose his life in V7, but this first flight proved a tremendous success. The only problem was the destruction of the trolley, which had been jettisoned on schedule but had dropped like a stone to the ground without its parachutes deployed. After a second trolley was lost in a similar way, flight testing reverted to jettisoning at take off.

A total of seven prototypes was completed, the third being the first preproduction standard example with cabin pressurization and an ejection seat for the pilot, and three inset lugs outboard of the engine nacelles for attaching RATOG (rocket assisted take-off gear). Meanwhile, it had



been decided to increase the aircraft's land mobility by abandoning the trolley take-off system and adopting a newly-designed nosewheel gear. Each unit of the new gear was fitted with a large low-pressure tire, the nosewheel retracting into a compartment to the rear of the cockpit and the main units retracting forward and inward into a wider fuselage. The result of this arrangement was to give the undercarriage a very narrow track. By virtue of the modifications, the 'A' series Ar 234 was abandoned in favor of the Ar 234B.

For series production of the Ar 234B, assembly lines were established at Alt Lönnewitz. Some reports that appeared in Britain soon after the end of the war suggested that the first Ar 234B flew in December 1943. This is incorrect. The first of only three Ar 234B prototypes to fly before the first of twenty preproduction Ar 234B-Os, on 8 June 1944, was Ar 234 V9, which flew on 10 March 1944. It must be assumed, therefore, that the early reports mistook the Ar 234 V5 as a series 'B' type. This aircraft, which indeed flew on 20 December 1943, was the first to have the lightened 840kg (1852lb) thrust Jumo 109-004B-0 turbojets installed. In other respects V5 was a true 'A' series aircraft, but might have confused matters further by lacking a pressurized cabin for the pilot, a feature common to the Ar 234B-Os. Ejection seats were also deleted from Ar 234B-Os.

Ar 234B-Os were completed with provision for two reconnaissance cameras each, with a choice of two Rb 75/30s, two Rb 50/30s, or one Rb 20/30 and one Rb 75/30. Of the twenty, the statutory thirteen were delivered to the flight-proving center at Rechlin, where they were used for evaluation purposes. Meanwhile, V5 and V7 had undertaken the first actual operations, with 1 Staffel/Versuchsverband Ob d L, the first on 20 July from an airfield at Juvincourt only ten days after KG 51 Kommando Schenk had arrived there with its Me 262s. By the following September the unit had moved twice and was then to be found at Rheine, where two Ar 234B-Os joined the single remaining prototype. Within a short time full production Ar 234B-1 reconnaissance aircraft began to appear, allowing the formation of the first operational unit proper as Sonderkommando Götz, although this unit drew only partial strength from the previous evaluation Staffel. By November two more special Arado units were forming. Operation of the three special units lasted only a short time, giving way in January 1945 to three newly-formed squadrons based at Rheine and in Denmark.

The Ar 234B-1 was purely a reconnaissance aircraft, as originally specified, but had provision for drop tanks to increase the operating radius. Again some reports that appeared in Britain after the war suggested that provision was made for each B-1 to carry two rear-firing 20mm MG 151 cannon with 200 rounds of ammunition per gun. It is not clear how many, if indeed any, actually carried defensive armament, especially in view of the fact that the Blitz was expected to have a performance sufficiently high to make interception very unlikely. Then to be considered is the detrimental effect the weight of cannon and ammunition would have on overall speed and range. Many of the operational photographic reconnaissance missions were over British airfields and harbors and these were not generally troubled by defending fighter planes. Operating altitude for the Blitz was normally about 9000m (29,500ft).

From the outset it had been recognized that the Ar 234B-1 could be superseded by an improved B-2 model, which itself could have several sub-variants to include combat types. Certainly the Blitz had the performance to make it a devastating offensive weapon. It was therefore only a matter of time before the B-2 was in hand for photographic reconnaissance, pathfinding and bombing roles. Each Ar 234B-2 had a tail parachute stowed in the rear fuselage for braking to reduce landing distance, the same 20mm cannon defensive armament as mentioned previously, and Patin PDS three-axis autopilot to allow the single crew member to use the Lotfe 7K bombsight. Various bomb combinations were possible, including the carriage of one 1000kg bomb under the fuselage and one 500kg bomb under each engine nacelle, although a total warload of 1000kg was fairly normal. Maximum speed of the Ar 234B-2 was 742km/h (461mph) at 6000m (19,680ft), but this could be reduced by as much as 97km/h (60mph) when carrying a full warload. Normal take-off weight was 8400kg (18,520lb), although 8850kg (19,510lb) was the maximum permissible take-off weight without rocket assistance and 9800kg (21,605lb) with RATOG. Service ceiling was approximately 10,000m (32,800ft), but altitudes in excess of 11,500m (37,730ft) were obtainable. Range was up to 1630km (1,000 miles). Take-off distance with and without RATOG, carrying a 1500kg warload, was 1785m (5,860ft) and 860m (2820ft) respectively.

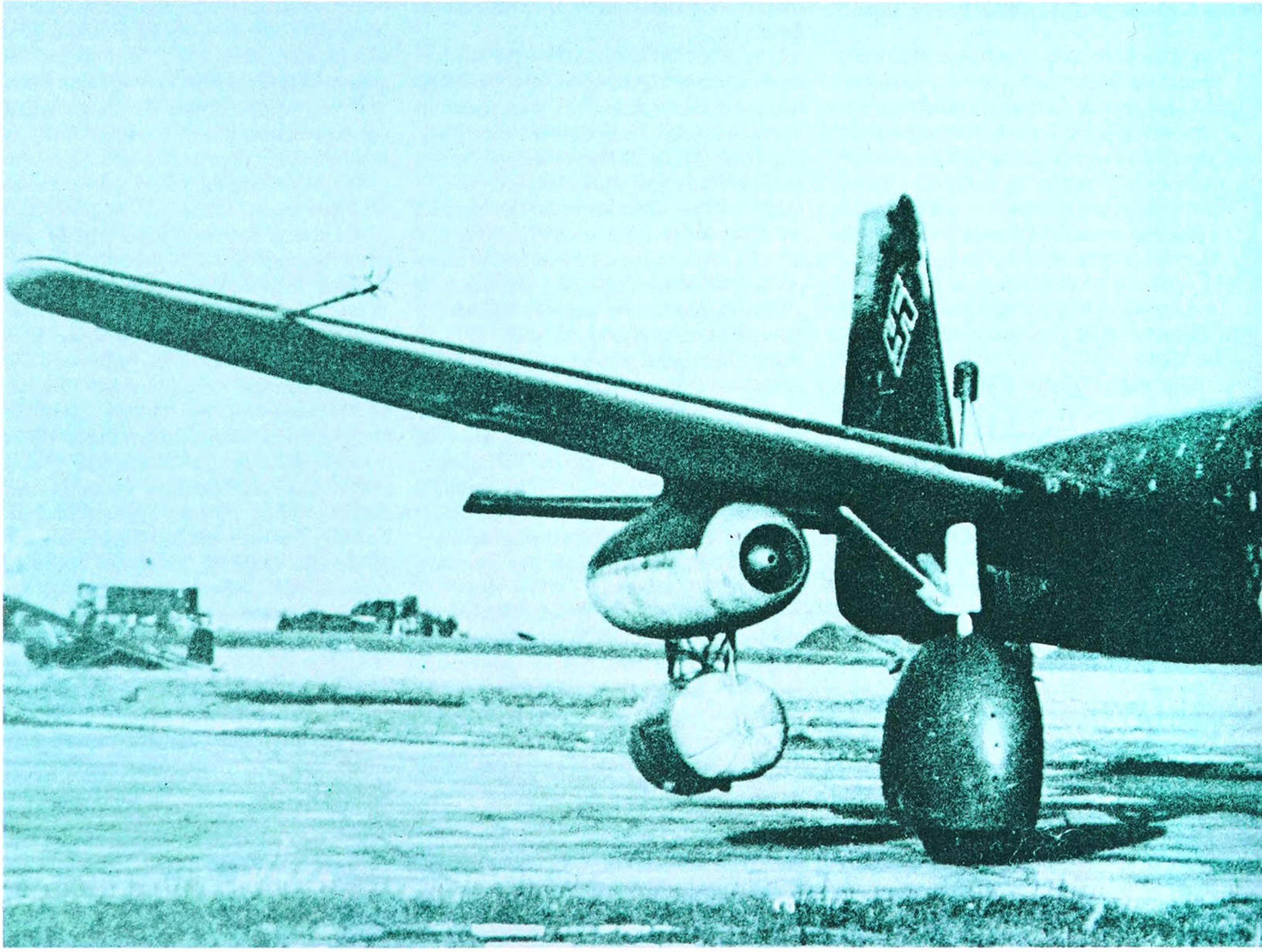
In October 1944 the first B-2 bombers became available to Kampfgeschwader 76. Pilots were trained to fly these jets on two-seat Messerschmitt Me 262B-la conversion aircraft of IV(Erg)/KG 51 at the factory site. The first Gruppe of this unit flew the first operational missions by a purpose-built jet bomber, flying from Rheine and Achmer to attack Allied targets during the Ardennes offensive which started on 16 December 1944 and continued until 16 January. By then other Gruppe of KG 76 were in training. Between then and the end of the war in Europe, Arado bomber units suffered severe fuel shortages and were moved from one base to another as the situation grew ever more desperate for Germany. Then, on 24 February 1945, an Ar 234B-2 from III Gruppe of KG 76 operating with other B-2s and Me 262 fighter-bombers, lost engine power and was forced down by USAAF piston-engined fighters near Segelsdorf. This Blitz was captured by US ground forces on the following day, the first Ar 234 to be taken in one piece by the Allies. During much of early March KG 76 and accompanying Me 262 fighter-bombers attempted to hold up the Allied crossings of the Rhine. This was undoubtedly the high-point in the career of the Blitz bomber.

Although a small number of new Blitz aircraft were delivered to operational units thereafter, by the beginning of April what remained of KG 76 was grouped at four locations, each with only a handful of aircraft at most. From then on the situation became daily more hopeless and fewer and fewer attacks were mounted. In the forty months that separated the appearance of

the first Ar 234 airframes and the end of the war in Europe, fewer than 250 operational Blitz aircraft had been built, most of which were of the 'B' series.

Going back to the spring of 1942, the serious problems BMW were experiencing with its 109-003 turbojet engine were going to take a further year and a half of work to put right before this company too had a viable engine for production. In October 1943, however, BMW demonstrated its redesigned 109-003A in the air. Lighter than the 004, it proved suitable for use in production aircraft, although later series-built 003A-1 engines still had problems to be resolved. The availability of the BMW and the ease at which the Ar 234 had completed early flight trials led to much forward thinking. Beyond the Ar 234B was considered the 'C' type, powered by no less than four BMW turbojets. The RLM's confidence in the Blitz, and to a similar extent the manufacturer's, was shown clearly by the single act of assigning two of the original Ar 234 prototypes to the development of a 'C' series. Naturally both V6 and V8 had trolley/skid undercarriages, but V6 featured four turbojet engines spaced under the wings and V8 had them in two paired nacelles. The first to fly was V8, on 1 February 1944. It was this configuration that proved the most suitable. Several prototypes for the Ar 234C were flown thereafter, the first prototype proper being V19 with 003A-1 engines and incorporating several design innovations. This aircraft flew on the last day of September 1944. V20 appeared in October and featured a redesigned cockpit with double glazing for pressurization.

Several 'C' series variants were planned, each with the height of the cockpit raised to improve vision and using double-glazed panels, redesigned ailerons, air brakes and an enlarged nosewheel among refinements. In the event only some nine production Ar 234C-1 single-seat reconnaissance aircraft and five pre-production C-3 combat aircraft were constructed, none of which went into action before Germany's capitulation. Other variants planned included the Ar 234C-4 and C-5 reconnaissance machines, the former with four cannon for defense and the latter a two-seater; C-2, C-5 two-seater and twin Jumo 109-004D-engined C-8 bombers; and the C-7 two-seat night fighter with a choice of engines, including the 003A-1 from BMW and the Heinkel-Hirth 109-011A. The latter was a second-generation turbojet, the work of von Ohain and initially known as the S.11. Intended to have a thrust of 1300kg (2866lb), it had many innovations including a two-position variable exhaust nozzle. Contemporary reports suggest that this was seen as the driving force for a variable-pitch propeller, for use on a future bomber, as projected under the engine



number 021. Actually, the S.11 was the initial stage in the development of the 021, but was put into production towards the end of hostilities.

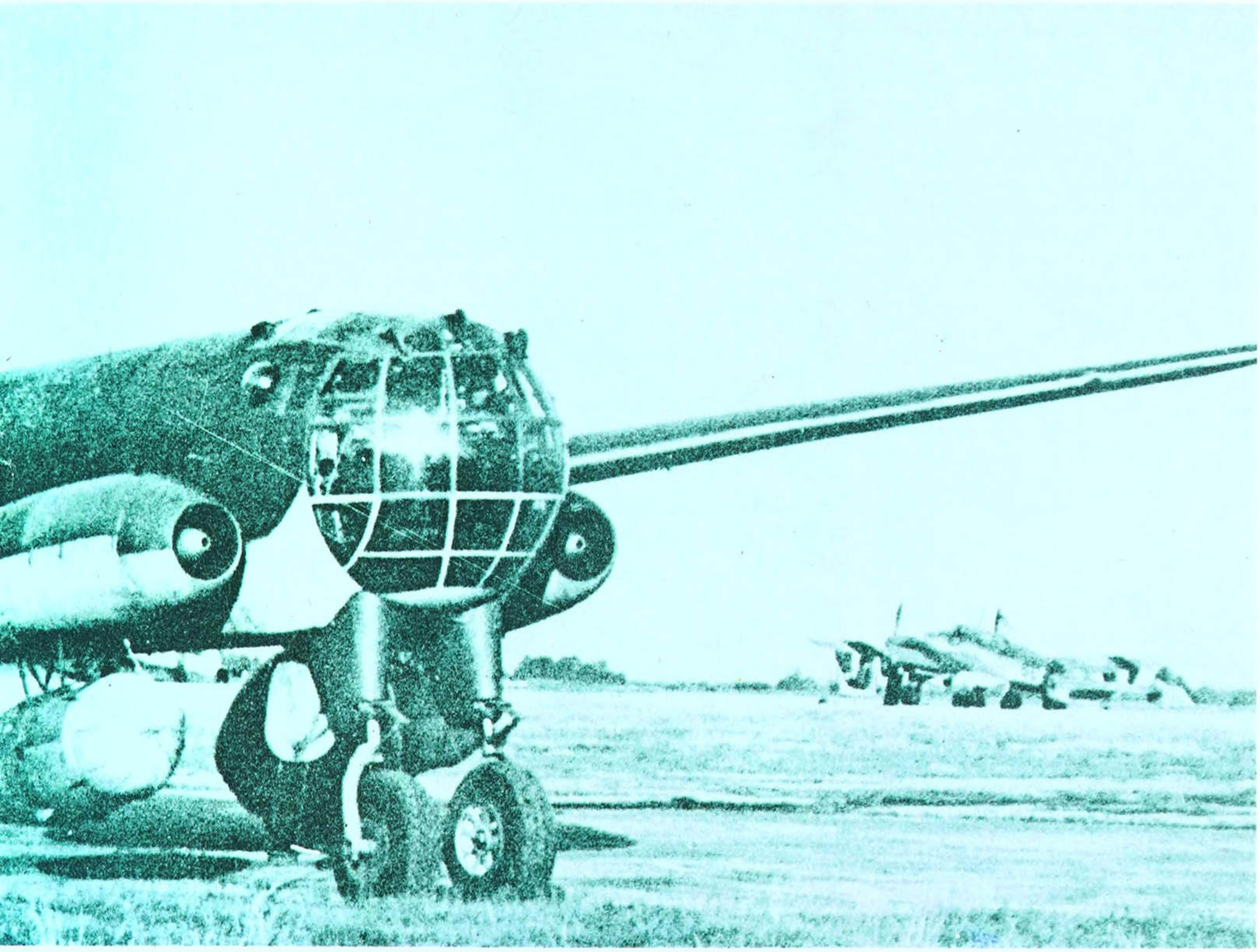
An enormous number of experimental and prototype S.11s were ordered to speed up development. After some of the second series of engines had been completed, development shifted to the 011A-0 preproduction model. By January 1945 four engines of the second series alone had accumulated more than 180 running hours. Progress with the Ar 234C series was, however, severely disrupted by Allied bombing raids. Maximum speed of the Ar 234C was 874km/h (543mph) at 6000m (19,680ft) and endurance at 60 percent power was approximately 1.25 hours. Several other versions of the Blitz were considered and interesting experiments included the famous Diechselschlepp trials, which involved the Blitz towing a jettisonable long-range fuel tank, or one of various missiles.

The Heinkel-Hirth 109-011A engine was also selected as one of the possible powerplants for other projected bombers, the only two to have prototypes put in hand being the Junkers Ju 287 heavy bomber and the diminutive Henschel Hs 132 dive bomber and ground attack jet. The Ju 287 would have been the world's first heavy jet bomber had it achieved operational status.

Development of the Ju 287 started in 1943, when it became known that a new heavy bomber was required for the Luftwaffe as an eventual replacement for the Heinkel He 177 Greif. The Greif had had a particularly troublesome service career up to this date and had earned the nickname 'Flaming Coffin.' The Ju 287 was to be a revolutionary replacement, not only having turbojet engines but incorporating advanced design wings using technical data on swept wings obtained by official research institutes. The main task was to produce a bomber that could outfly all Allied fighters. Of course Junkers had not been the only manufacturer to put pen to paper. Heinkel produced its four-turbojet He 343 design and Blohm und Voss produced several designs for four-jet bombers, each with a unique W-form wing that it was thought would combine the best flying characteristics of forward and swept-back wings. To avoid confusion with other major bomber projects of the period, it should be made clear at this point that of these projected Greif replacements only the Ju 287 continued to prototype construction stage.

In charge of the Junkers Ju 287 project was Dipl Ing Wocke, who recognized the value of swept wings for achieving high speed flight but also saw the dangers they

Junkers Ju 287 V1 with Walter 501 rocket motors attached below each engine pod.



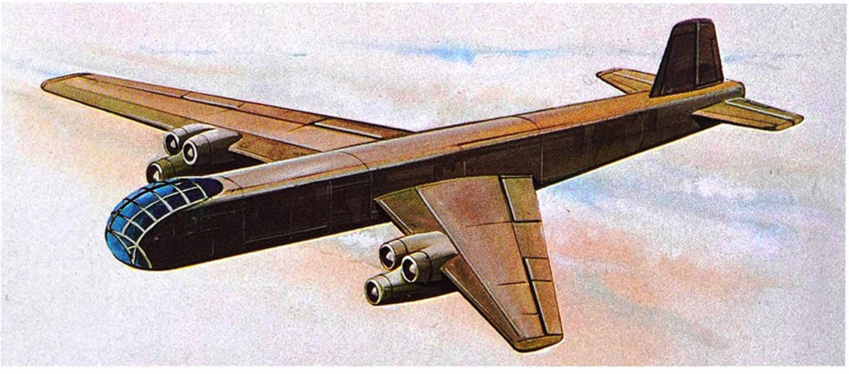
bestowed for low speed flying. He therefore proposed a wing configuration nearly as strange as that being expounded by Blohm und Voss. Instead of a sweptback wing with a 25 degree sweep, he proposed that the wings of his bomber should be swept forward. Wind tunnel tests showed clearly that whilst low speed flying characteristics were improved over and above sweptback swings, some destabilizing effects resulted at high speed which affected the structure. Nonetheless, the high speed problems were considered less of a worry and work on the bomber prototypes began.

As a first stage, and in order to test the wing configuration at low flying speeds, it was decided to fit newly-built forward swept wings to a readily available fuselage as near to that of the projected bomber as possible. There was only one obvious candidate, and a Greif fuselage received the wings and various component parts from other Junkers aircraft. As a suitable retractable undercarriage was going to be difficult to fit, and was anyway superfluous, a fixed arrangement with large faired wheels under the wings and a twin-wheel nosegear was used. The nosewheels came from the USAAF, having been stripped from a captured B-24 Liberator. The all-important engines were four 900kg (1984lb) Jumo 109-004-B-1s, two in pods under the wings and two mounted either side of the nose. Contemporary reports suggested that the Ju 287 was intended ultimately to use only two new-generation BMW or Junkers turbojets in the 2500-3200kg (5500-7050lb) thrust range. This is interesting and indicates the importance attached to the long-term development of the BMW 109-018 and the Junkers 109-012. The 018 was never completed but would have been a turbojet with a 12-stage axial compressor, a three-stage turbine and a variable exhaust nozzle. Thrust rating was expected to be 3400kg (7496lb). The 012 was in fact the favored engine for the long-term Ju 287 variant, although Germany's capitulation left no time for completion. This smaller engine comprised an 11-stage axial compressor and a two-stage turbine, allowing for a thrust of around 2800kg (6170lb). Interestingly, the BMW engine designation 109-028 applied to a projected variant of the 018, modified to drive contra-rotating propellers. The projected engines apart, actual preproduction and production Ju 287As were to have six BMW 003A-1s each, followed by the initial 'B' series aircraft with four 109-011As.

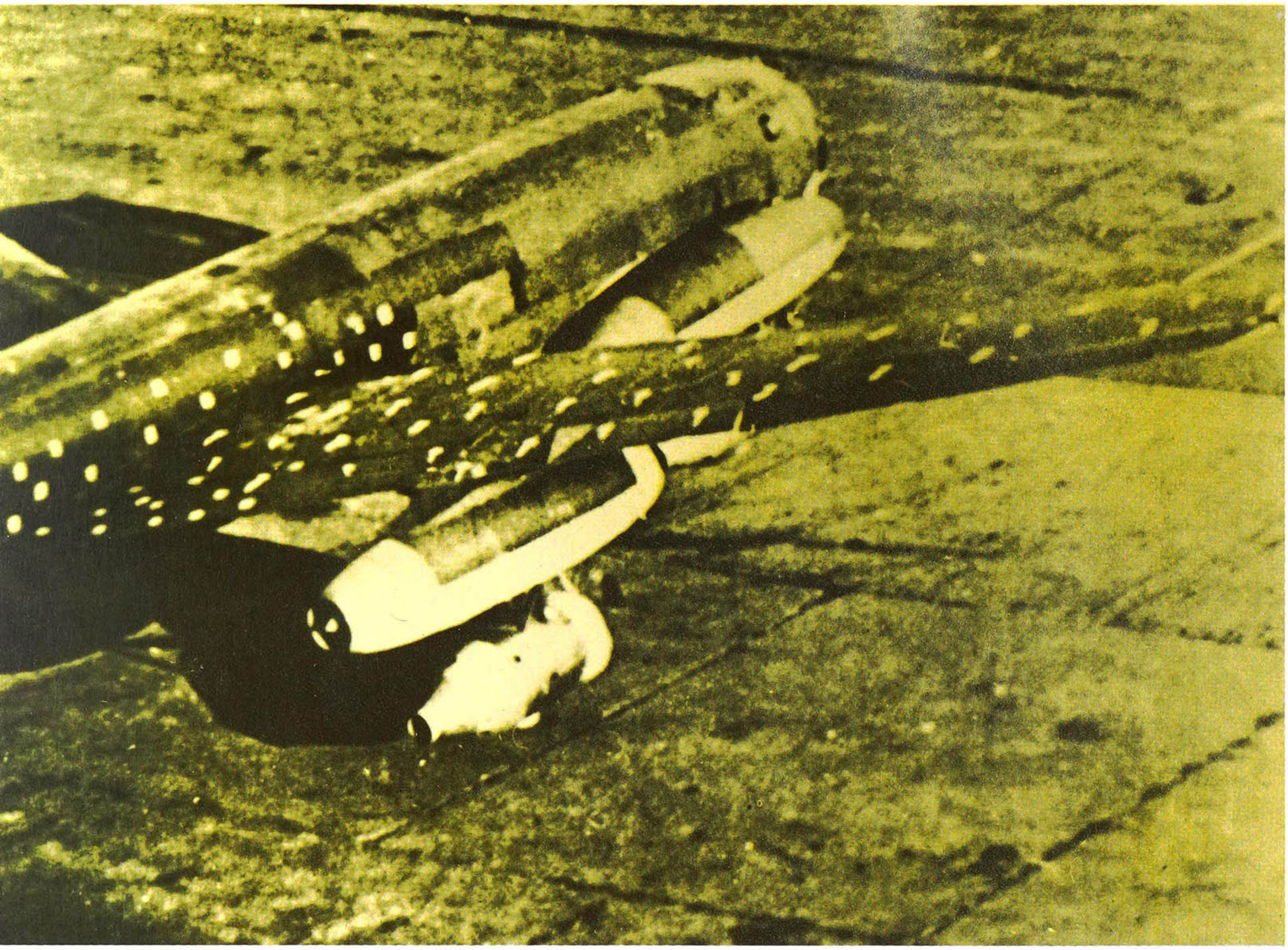
The resulting misfit was known as the Ju 287 V1 and was a two-seater: the actual Ju 287 was to be a three-seater with accommodation for a pilot in a Ju 288-style raised cockpit, bomb-aimer/navigator and radio operator/gunner for the remotely-controlled tail turret fitted with two 13mm MG 131 machine-guns (Ju 188C style).

With just the four 004B-1s fitted it was clear that the Ju 287 V1 was going to be underpowered, and so it was moved to Brandis for flight trials to make use of the very long runway. The first of 17 flights was recorded on 16 August 1944. Additional power was provided by Walter 501 rocker motors attached to each engine pod and jettisoned after height had been achieved. During the trials the aircraft proved virtually vice-free, although landing speeds were high.

Construction of two actual Ju 287 pro-



This artist's impression shows how the Ju 287 V2 might have looked if completed in Germany.



The wing position of the Ju 287 V1 is clearly shown from this view.

totypes began thereafter, V3 using the expected production 'A' series layout of four underwing 003A-1s and two nose mounted engines and V2 with three engines in clusters under each wing. However, in the Summer of 1944, when fighter production and development were given the utmost priority in view of the round-the-clock Allied bombing raids on Germany, the Ju 287 was abandoned. Then, in early 1945, despite the ever worsening situation, work restarted on the V2 and V3 at Leipzig, but only V2 reached assembly stage. Soviet forces eventually captured the factory and took V1 and V2 back to the Soviet Union, where V2 was fitted with sweptback wings and flown in 1947. Completion was helped by Junkers staff sent to Podberezhye the previous year. It is difficult to see what was gained by the completion of V2 in the Soviet Union, as by 1947 that nation had its own Tupolev Tu-73 and Tu-77 prototype turbojet-powered bombers flying. The answer must be that this aircraft made convenient engine test-bed for evaluating captured engines and allowed early research into swept wings.

As for the Henschel Hs 132, this too stopped at three prototypes, all of which were taken over by Soviet forces. However, several interesting points accrue from this project. It is an historical fact that the shortest time to elapse between a contract being issued for a new jet fighter and the first flight of a prototype was the 69 days taken for the small Heinkel He 162. Built in a time of acute strategic material shortages, it used wooden wings and a metal fuselage, the engine being mounted above the fuselage. The simplicity of the He 162, which first flew at the end of 1944, undoubtedly influenced Henschel when it designed its Hs 132 dive-bomber and ground attack jet. This too had a small cigar-shaped fuselage, wooden wings and a dorsal-mounted turbojet. However, because of its role, the pilot lay in a prone position looking through a heavily-glazed forward fuselage. The pilot and structure were expected to withstand a load factor of up to 12g. The maximum designed speed was 792km/h (492mph) at 900m (2950ft) without a bombload. Prototype construction started in March 1945 and at least the first was virtually ready to fly when peace intervened. There is no evidence to suggest that the Hs 132 influenced any post-war Soviet thinking. Nor did the experimental aircraft with prone accommodation for the pilots that appeared in Britain, the United States and elsewhere after the war owe anything to the German machine. Viewed in retrospect, the Hs 132 would probably have been a very simple combat aircraft to construct, but difficult to fly.

May 1945 brought the capitulation of Germany and an end to the war in Europe. It also marked the end of jet bomber development in Germany, for no other jet bomber has been produced in that country since 1945. That country's contribution to aviation history, however, cannot be overstated, introducing as it did the world's first turbojet-powered aircraft, the first turbojet-powered fighter, the first turbojet-powered reconnaissance aircraft, the first turbojet-powered bomber, the first turbojet-powered heavy bomber, and the first turbojet-powered dive-bomber (completed but not flown).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2: BACKING THE BOMBER

The end of World War II saw Germany divided and in ruins. For the remainder of 1945 Britain had the only air force in the world with an operational jet fighter force, but appeared in no hurry to deploy a jet bomber. Having fought hard and long to achieve victory, Britain could not envisage being involved in another major war until at least the 1950s. It was undoubtedly this line of thinking that also delayed the development of a swept-wing fighter in Britain. Another consideration was the practical side of producing a jet bomber using the turbojet engines then available. Although Germany had accepted jet bombers into service with short ranges and light warloads, there appeared no point in rushing the production of a bomber if the end product could not strike hard at long distance targets. No future war was likely to require a bomber with only sufficient range to reach France or Germany. Therefore, it was not until 1949 that the first British jet bomber flew, having been developed at a moderate pace to Specification B.3/45.

Previous page: The Boeing B-47E Stratojet introduced a new 'solid' nose with a refueling probe.

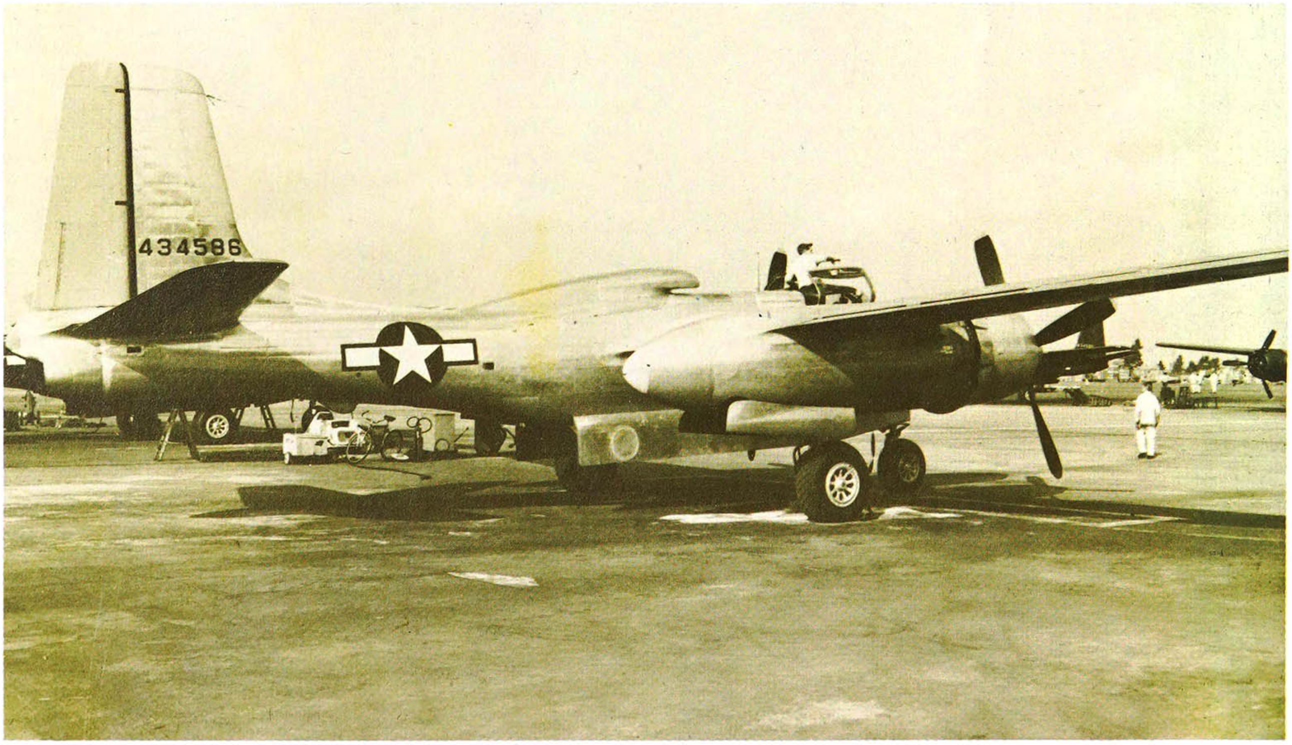
The experimental Douglas XA-26F. Note the air-scoop above the fuselage. Fuel for the turbojet engine was carried in the upper rear section of the bomb-bay.

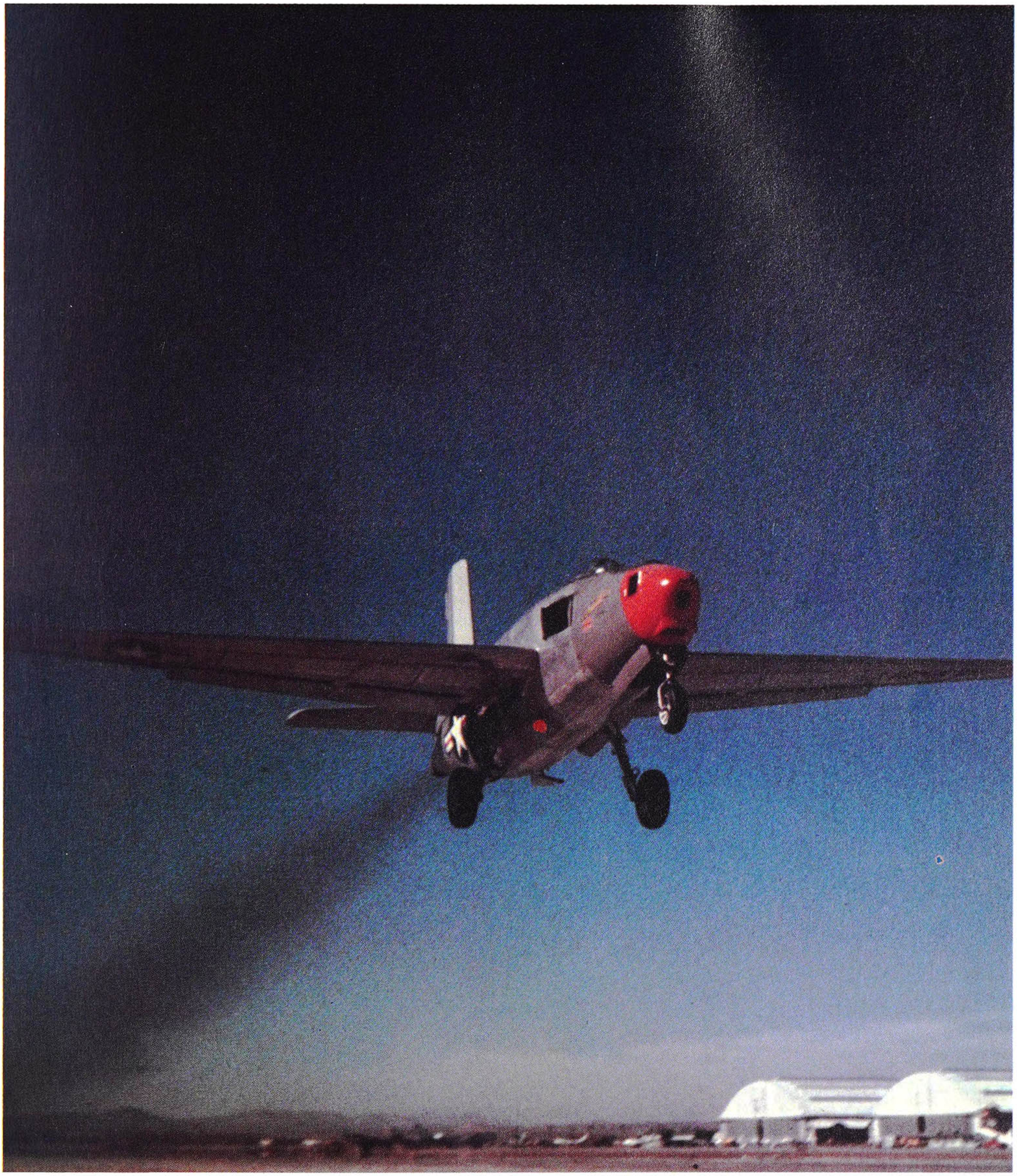
Such considerations were not shared by other countries. Both the United States and the Soviet Union accelerated development of jet fighters and bombers, the latter having much ground to make up. The United States was in the happier position, having its own turbojet engines in production and with deliveries of P-80 Shooting Star fighters beginning in late 1945. The mighty resources of the US had been turned to war production after the shattering blow of Pearl Harbor, the legacy of which was not only to make the nation one of the major postwar arms producers, but forced upon it the unenviable role of 'superpower,' for it alone had the atomic bomb.

Development of US jet bombers can be traced back to World War II, although the first purpose-designed jet bomber did not fly until 1946. In October 1941 the General Electric Company received from Britain a Whittle turbojet engine, drawings for the Whittle W2B turbojet and a team of British engineers with a view to establishing a turbojet production line in the US. The Americans equivalent of the W2B became known as the I-A, an experimental engine which powered the Bell P-59 Airacomet. From the I-A General Electric developed the I-16, a 'thirsty,' centrifugal-flow engine which later received the military designation J31. Apart from becoming the powerplant for the production Airacomet and the tail engine of the Ryan FR-1 Fireball, the Douglas Aircraft Company installed an I-16 in the tail of an A-26 Invader attack bomber as the experimental XA-26F. This installation meant the deletion of turret armament, but was intended to add 56km/h (35mph) to the aircraft's maximum speed. The main engines were two Pratt & Whitney R-2800-83 radials. In the event, hostilities with Japan ended some weeks before the XA-26F was ready for testing, but on 26 June 1946 it established a new world speed record over a 1000km course while carrying a 1000kg payload of 664km/h (413mph). For this record attempt the I-16 was in operation for 45 minutes. The maximum speed of the XA-26F was 700km/h (435mph).

The first Douglas XB-43 Mixmaster, with a plywood nosecone fitted in place of the fully-transparent bomb-aiming nose.

Prior to the XA-26F, Douglas had designed and built two prototypes of its XB-42 Mixmaster bomber to an Air Technical Service Command contract, these having flown on 6 May and 1 August 1944. Apart from cockpit canopy arrangements for the pilot and copilot, the two were similar. Each had mid-mounted straight wings, a glazed fusel-





age nose for the bombardier, cruciform tail surfaces (the lower fin protecting the propellers), and rear-mounted Curtiss Electric co-axial contra-rotating propellers driven by two Allison V-1710-125 piston engines installed side by side within the center fuselage. Because of its low drag configuration, powerful engine arrangement and large fuel tanks, the XB-42 had a possible range of more than 8050km (5000 miles) and a maximum speed in excess of 659km/h (410mph). Maximum warload was 3629kg (8000lb), carried in the weapons bay, but with such a heavy load range would have been reduced dramatically. August 1945 brought an end to the war with Japan and an end to any hopes for production contracts. However, the XB-42 could boast a performance far greater than any other piston-engined aircraft in its class. Indeed, this 16,190kg (35,702lb) all-up weight bomber

was only a quarter as heavy as the Boeing B-29 Superfortress and yet its performance could be compared favorably with the B-29's, which was then the mainstay of the USAAF's long-range heavy bomber force.

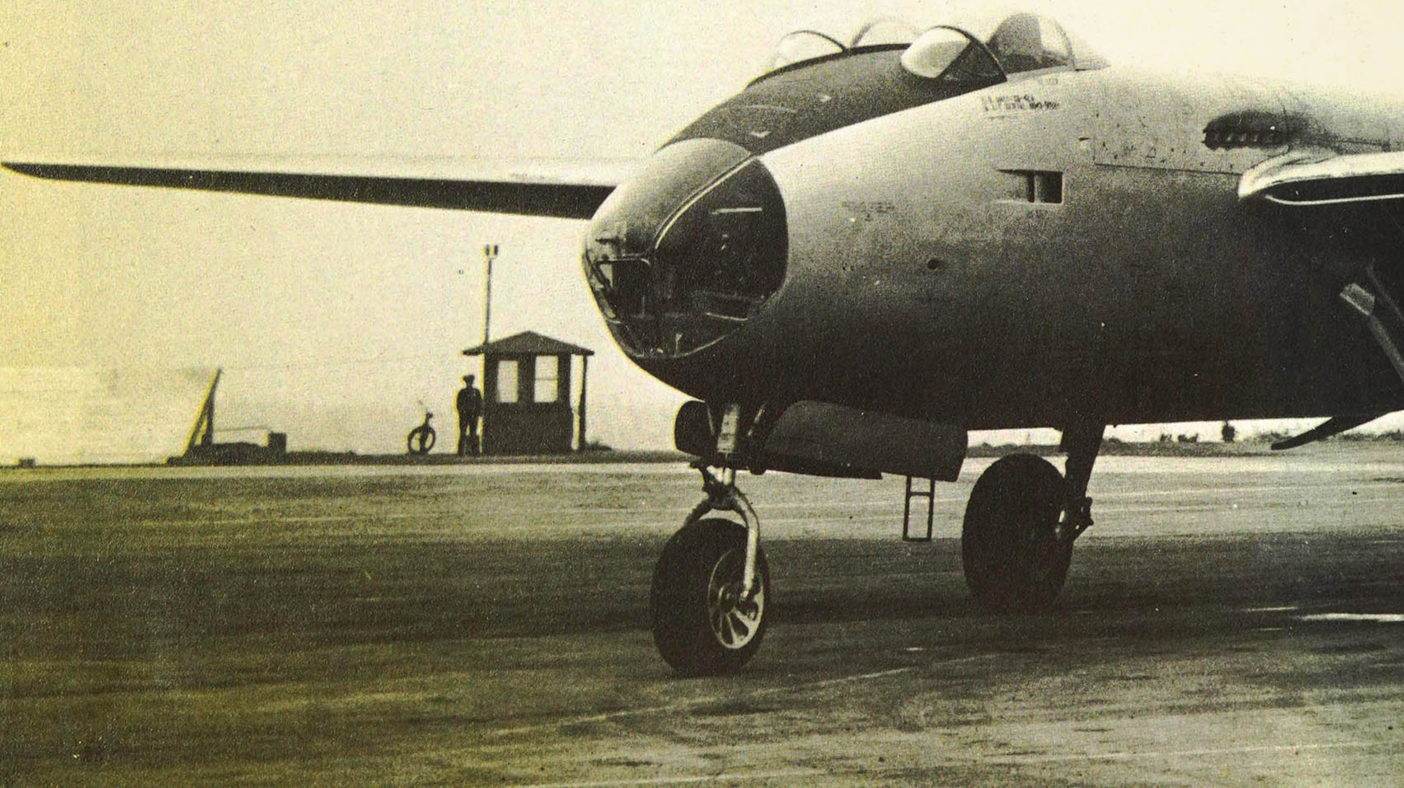
At this stage Douglas turned to jet bombers, as it was obvious that the USAAF did not intend to procure many piston-engined bombers and fighters postwar. However, the circumstances of this changeover have often been mistakenly reported, quoting the first Mixmaster when modified as an interim jet/piston-engined bomber. This was the XB-42A. In fact the Mixmaster design was first considered for turbojet power back in 1943, before an XB-42 had ever flown. An order for two jet-powered XB43s was placed in early 1944, but the practicality of such a bomber only came about with the development of the General Electric TG-180 turbojet engine, the company's first axial-flow engine which later received the military designation J35. The TG180 not only gave a thrust of 1700kg (3750lb) for take-off, but, because it had an 11-stage axial-flow compressor, it was less thirsty for fuel and had a smaller diameter than earlier centrifugal-flow engines.

The first XB-43 took to the air on 17 May 1946, at the Muroc experimental test base in California. Because it belonged to the USAAF and carried a military serial, this aircraft became the Air Force's first jet bomber. In most respects the XB-43 looked like the first XB-42, even having the twin separate cockpit canopies for the pilot and co-pilot. The main external changes were the introduction of air intakes for the turbojets forward of the wings, the use of a conventional tail unit, and the twin exhaust nozzles below the tailplane. Maximum speed proved to be 828km/h (515mph). A second example flew thereafter, but the bomber remained a prototype. Douglas had made history with its XB-43 but had not received a contract for production examples.

Meanwhile, in December 1945 the second XB-42 had crashed, leaving one remaining prototype. It had been decided to use this Mixmaster for experiments with auxiliary turbojet engines (not as an interim bomber for the XB-43), and in due course it reappeared as the XB-42A, powered by two V-1710-133 piston engines and two 727kg (1600kg st) Westinghouse 19XB-2A turbojets mounted in pods under the wings. The 19XB-2A had a single-stage turbine and six-stage axial-flow compressor. It is best remembered as the powerplant for the US Navy's first jet fighter, the McDonnell FD-1 Phantom, when it carried the military designation 330. The re-engined Mixmaster was flown for the first time on 27 May 1947 and proved capable of adding nearly 129km/h (80mph) to its previous maximum speed, in fact not far short of the XB-43's top speed, a remarkable feat.

In 1947 the newly created USAF Strategic Air Command received its first Boeing B-50 heavy bombers and intercontinental-range Convair B-36s. These marked the end of the line for piston-engined bombers. Five radical new bombers also flew as prototypes in 1947, all but the Northrop aircraft having been designed to a 1944 specification for an all-jet bomber and photographic-reconnaissance aircraft capable of a 1600km (1000 mile) radius of action and a maximum speed of 804km/h (500mph). The favored warload included carriage of a 22,000lb bomb or many 1000lb bombs. An atomic bomb was later added as an option. In fact the requirements were not difficult to fulfil, resulting in a mixture of tactical, medium and heavy bombers. All started at design stage as straight-wing aircraft with four engines, except for the Martin contender with six. The chosen engine for the prototypes was the TG-180 or J35, which was initially produced by General

Douglas XB-42A with piston engines and Westinghouse turbojets.

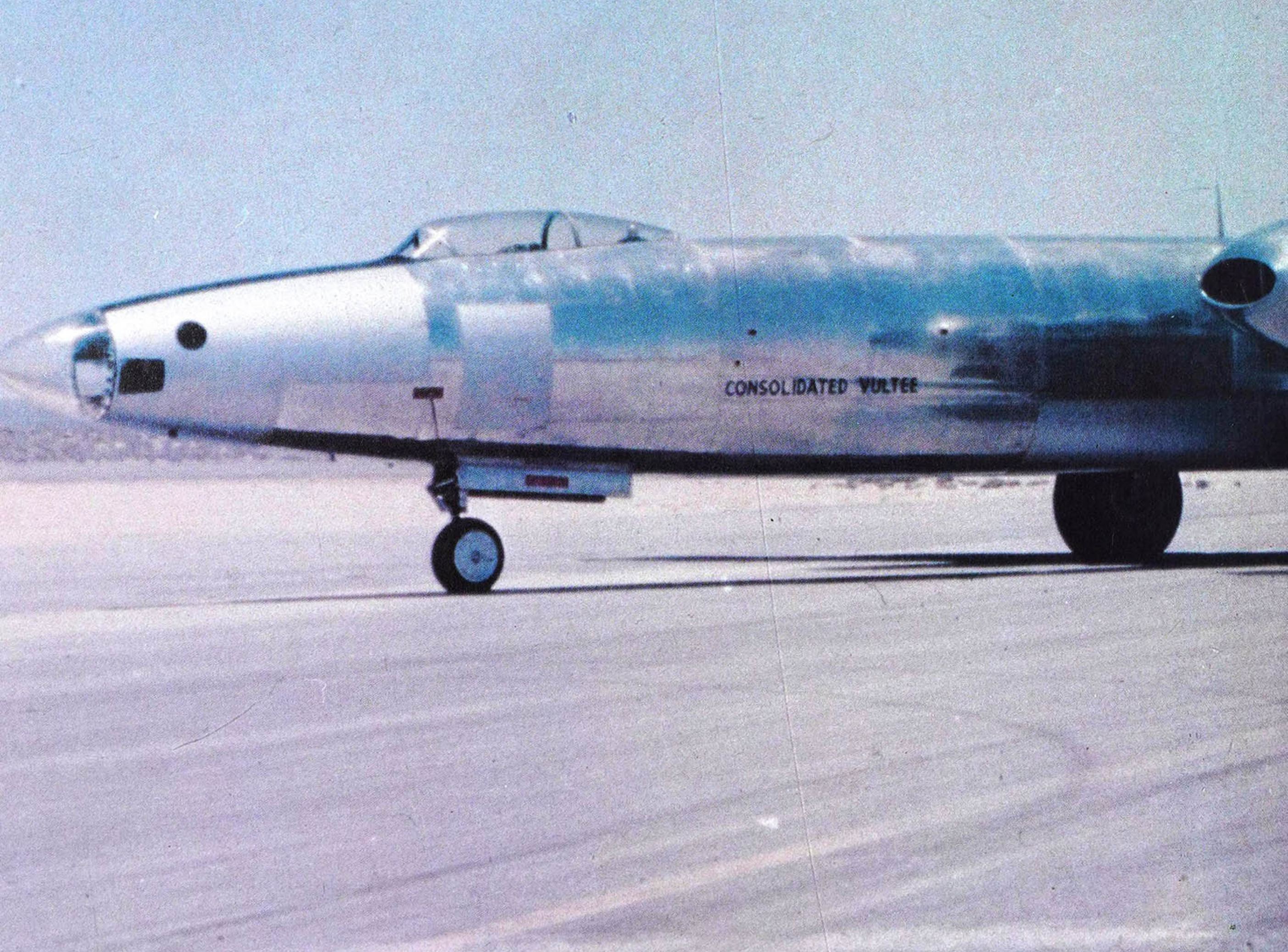


Above: The second of three North American XB-45 Tornados.

Electric and the Chevrolet and Allison Divisions of General Motors, Allison subsequently taking over development and production of the engine.

The first of these bombers to fly was the North American NA 130, remembered as the B-45 Tornado. Except for its turbojets paired in nacelles, it was a conventional design. The protruding engine nacelles allowed the complete engines to be enclosed forward of the shoulder-mounted wings for easy maintenance. The oval-section fuselage accommodated a bombardier in the glazed nose compartment, the pilot and copilot in tandem under a long canopy and approximately nine tons of bombs in an internal bomb bay. For defense against fighters approaching from the rear it had been intended to install a radar-

North American B-45A Tornado, the major production version.



operated gun system in the tail. However, as this was not ready in time, a fourth crew member was assigned the task of firing the two 0.50 in Brownings. The tail unit was conventional except for its tailplane which had pronounced dihedral, and the undercarriage was a nosewheel type.

Three XB-45 Tornado prototypes were built for evaluation, the first flying for the first time on 17 March 1947. Maximum speed was a little over 800km/h (500mph). With the prospect of installing the more powerful J47 engine into the Tornado to increase speed and warload, the aircraft was ordered into production. The J47 was a General Electric development of the J35, giving a thrust of 2359kg (5200lb) without sacrifice of weight or dimensions. However, the first examples of the B-45A initial production version were temporarily fitted with

Convair's slender XB-46.

The one and only XB-46. Funds from this programme were redirected into the XB-53 project.

J35s, but J47s subsequently became standard on all 97 aircraft built. Compared to the XB-45, the B-45A had revisions to the bombardier's compartment and undercarriage. Fourteen were subsequently modified into TB-45A high-speed tugs for the Chance Vought all-metal target glider, the operator occupying the tail-gunner's position.

Only 10 B-45Cs were completed as tactical support bombers, each with J47-GE-13 or -15 engines, large tip-tanks to supplement the 17,034 liters (4500 US gallons) of internal fuel and other changes. Maximum take-off weight increased considerably but the maximum speed now stood at 932km/h (579mph), far greater than that of the prototypes but similar to the first production version. Greater production success met the RB-45C high-altitude photographic reconnaissance derivative, 33 of which served with Tactical and Strategic Air Commands. The RB-45C also completed production of the Tornado, although other noncombat versions were created by conversion.

B-45 bombers entered service from late 1948 with the 47th Bombardment Group, based in the United States and Europe. The RB-45C served also in the Far East. Like its stablemate, the F-86 Sabre fighter, it saw action during the Korean War of the early 1950s. In retrospect the Tornado was the second most successful bomber of the original four, giving the USAF a decade of service. However, its adherence to convention in all but engines allowed it neither the production run nor length of service of the Boeing B-47, another of the 1947 prototypes and one that took best advantage of the turbojet engine. The B-45 was, however, the USAF's first four-engined jet bomber and first jet bomber in operational service.

Before the B-47 is described, mention has to be made of the Convair XB-46 and Martin XB-48. The XB-46 was the second of the 1947 bombers to fly, the one and only example flying for the first time on 2 April. This was a rather beautiful bomber with refined lines, representing the Consolidated Vultee Aircraft Corporation's (Convair) first such aircraft with turbojet engines. The latter were four J35-C-3s built by the Chevrolet Division of General Motors, grouped in pairs in nacelles which also housed the main units of the retractable undercarriage. The thin high aspect radio wings were mounted high on the long and slender oval-section cigar-shaped fuselage. Although the XB-46 carried no armament or radar for the manufacturer's and USAF flight trials, a notable feature of the

aircraft was its long bomb bay, fitted with fast-opening doors. The specified crew of three comprised a pilot and copilot seated in tandem under a fully-transparent fighter-type bubble canopy and a bombardier in a forward compartment fitted with a one-piece nose transparency. Normal maximum take-off weight of the XB-46 was 41,277kg (91,000lb), which included 16 1000lb bombs, although a 22,000lb bomb could be carried. Maximum speed, however, was disappointing, despite the aircraft achieving an aver-

age of 858km/h (533mph) on part of its delivery flight to the USAF's Wright Field, Ohio. Range was 4619km (2870 miles) with a warload of 3628kg (8000lb), and service ceiling was approximately 13,000m (43,000ft). The XB-46 was not selected for service with the USAF and neither was a projected photographic reconnaissance variant reportedly designated XF-21 (the USAF using 'F' designations for reconnaissance aircraft up to 1947).

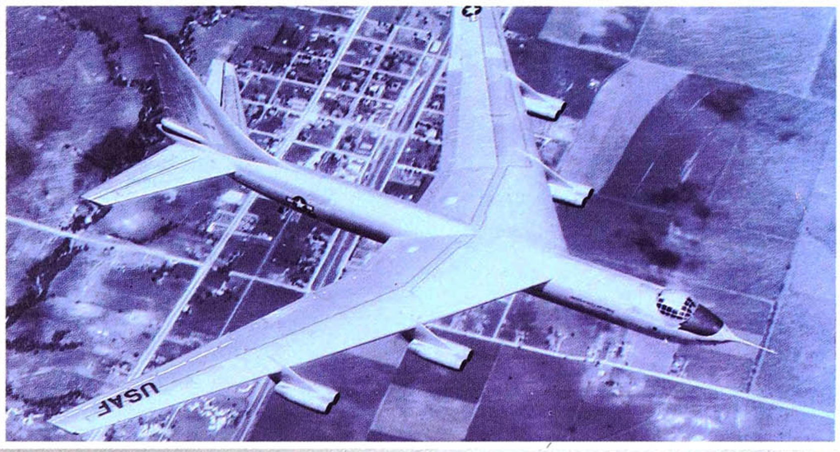
Of course, the Convair company had

Convair B-36 with four auxiliary turbojet engines under the outer sections of the wings.

achieved great success with its B-36 pusher-engined strategic bomber, which

not only was the largest US military aircraft in production at the period, but was the USAF's largest-ever bomber and the first strategic bomber with true intercontinental range. First flown as a prototype in August 1946, several versions were built, the B-36D third production model of 1942 introducing four J47 turbojet engines in pairs on pylons under the outer sections of the wings to supplement the six Pratt & Whitney R-4360 radial engines. This modification increased the bomber's over-target speed by 93km/h (58mph) to 707km/h (439mph). Maximum take-off weight also rose by nearly 13,600kg (30,000lb). The RB-36D was a reconnaissance variant of the B-36D. The RB-36E was a strategic reconnaissance modification of the B-36A with turbojets added and B-36F, H and J and RB-36F and M were later bomber and reconnaissance production aircraft respectively, all powered by radials and turbojets.

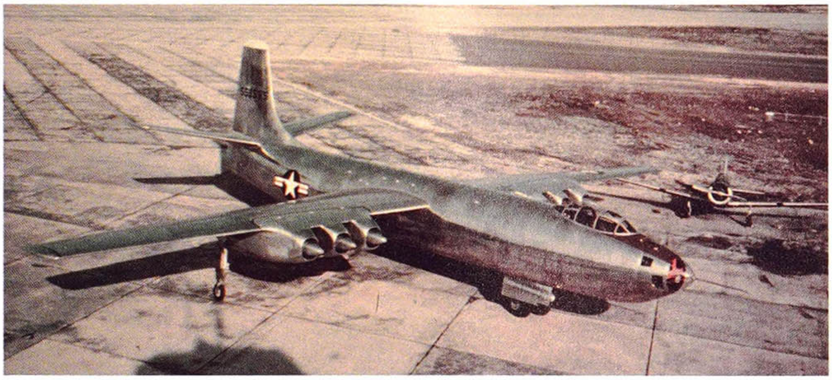
From the B-36 Convair developed the YB-60, two prototypes of which were built, the first flying on 18 April 1952. Completed to a USAF contract of March 1951, the YB-60 used a B-36 fuselage with a modified and pointed nose, a new tail unit and most importantly eight Pratt & Whitney J57 turbojets grouped in pairs under a new swept wing with a 62.97m (206ft) span (a reduction over the B-36's span of 7.3m (24ft). The J57, with a thrust rating of 3946kg (8700lb) in early form, was eventually to power many of the military and civil aircraft produced in the US, but at this time another important prototype it powered was the Boeing B-52. It was to compete against the B-52 that the YB-60 had been requested by the USAF.



Convair's eight turbojet-engined YB-60, pitted against the Boeing.

Returning to the 1947 bombers, the third to fly after the XB-45 and XB-46 was the XB-48. Produced by the Glenn L Martin Company, it was the first US bomber with six turbojet engines and flew for the first time in June. The first was delivered to the USAF for testing on 25 July. In many ways it was similar to the XB-45, having thin shoulder-mounted wings, a conventional tail unit with considerable tailplane dihedral, a tandem cockpit for the pilot and co-pilot and a nose compartment for the bombardier, and remotely controlled tail guns. The fuselage was comparatively short but deep, with the bomb bay positioned between the two pairs of mainwheels that retracted into the fuselage. Three Allison-built J35-A-5 turbojet engines were grouped in an angular nacelle under each wing. The outer sides of the nacelles housed the retractable stabilizing wheels of the undercarriage. Two XB-48 prototypes were built and their maximum speed was around 885km/h (550mph). The type failed to win production orders.

The second Boeing XB-47 stands alongside a piston-engined Boeing B-50.



Martin's six-jet XB-48

Interestingly, Martin was a little more successful applying turbojets to Navy aircraft, actually delivering 19 P4M Mercator long-range patrol aircraft to the US Navy from 1950. Each was powered by two Pratt & Whitney R-4360-4 radial engines and two Allison J33 centrifugal-flow turbojets, the latter housed in the rear of the same nacelles used by the radials and fed with air via intakes below the forward cowlings. Carrying a crew of ten, guns for defense and a heavy warload of bombs or mines, it could cruise at nearly 466km/h (290mph) on the radials alone and dash at a speed well over 160km/h (100mph) greater with all engines running.

A later attempt by Martin to produce a four turbojet-engined patrol flying-boat in the mid-1950s, brought about the P6M SeaMaster for the US Navy, which had a maximum speed of 966km/h (600mph). Just six pre-production and three production SeaMasters followed the prototypes, but none became operational. Ironically, the only true bomber turbojet-powered produced by Martin to reach operational status was its B-57, a license-built version of the British Canberra.

By far the most important of all the 1947 bombers was the Boeing B-47 Stratojet. Although this first flew as a prototype on 17 December and therefore after the Northrop YB-49, it was the last of the four bombers built to the original 1944 specification and so has to be mentioned first. The Stratojet also had the honor of becoming the USAF's first six-engined production jet bomber, the jet bomber built in greatest quantity in the western world and the first large bomber in the world with sweptback wings and tail surfaces.

The aircraft which is remembered as the Boeing Model 450 or B-47 Stratojet was very different from that proposed originally to the USAAF to fulfill the 1944 specification. Indeed, after the first proposal which covered a straight-winged bomber with four turbojet engines in paired nacelles as the Model 424, Boeing considered other configurations with straight and swept wings and with the engines in the fuselage. The idea of using swept wings at all had been one consequence of a visit to Germany by Boeing engineers after the war in Europe had ended. However, any thoughts of using the new jet against Japan were ended in August 1945. It was soon after this date that the latest Boeing design proposal featured sweptback wings for the first time, but still the design was unsatisfactory and so a new configuration was proposed as the Model 450.

The Model 450 was a shoulder-wing medium bomber, the thin wings having a 35 degree angle of sweepback. Six J35 turbojets were installed, two in pods near the wingtips and four in pairs on forward-swept pylons between the outer engines and the

The first Boeing B-47A Stratojet. Note the glazed nose, a feature of the B-47A and B.

fuselage. Auxiliary power for take off was provided by a total of 18 Aerojet solid-fuel JATO rocket motors (nine each side) installed within the fuselage aft of the wings. These provided a thrust of 8165kg (18,000lb) and were used to shorten take-off runs, allowing the bomber to use existing runways. Subsequently a ribbon-type braking parachute was developed for the bomber to reduce the landing run. As adopted by North American, Convair and Martin for their bombers, the crew comprised a pilot and copilot in tandem under a bubble-type canopy and a bombardier in the nose, and provision was made for tail armament for defense against fighters approaching from the rear. The latter was to comprise the usual twin 0.50in guns, either radar-

controlled or remotely-controlled by the copilot. The undercarriage was not unlike that fitted to the Martin XB-48, with two twin-wheel units forming the main gear and retracting into the underside of the pods.

Two XB-47 prototypes were built, the first with J35 engines taking to the air initially on 17 December 1947, having been rolled-out five days previously. The second prototype with J47 engines flew for the first time on 21 July 1948. On 7 October 1949 the first flew with J47s, the greater thrust of these engines proving ideal for the bomber. Meanwhile, on 8 February that year a prototype had crossed the United States non-stop in 3 hours 46 minutes, averaging 976km/h (607mph).

With the rather unusual-looking B-36 intercontinental bomber going into USAF service, it would not be surprising if the 10 production B47As ordered from Boeing for

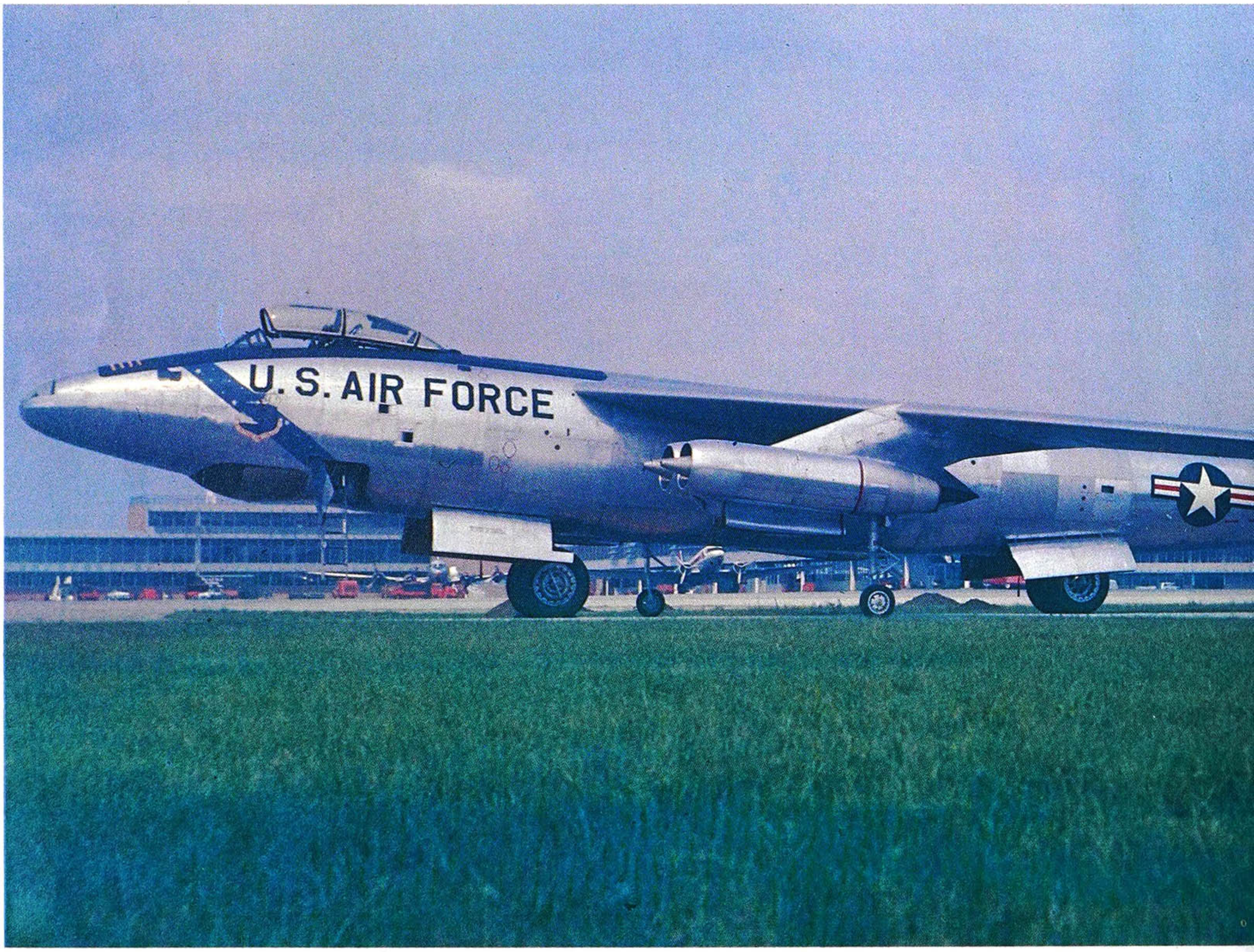
operational evaluation were too futuristic for some. These were followed by 87 B-47Bs. The first of the B-47As flew on 25 June 1950. Compared to the XB-47s, the B-47A had J47-GE-11 engines and JATO rockets with a combined thrust of 9070kg (20,000lb). The maximum take off weight of 73,709kg (162,500lb) remained the same.

World events now took control over the B-47, allowing an immediate injection of finance to rush Stratojets into USAF service. On the very day the first B-47A flew, forces from North Korea moved south and the Korean War began. As mentioned previously, the first B-47As had already been ordered, changes including provision for two large underwing drop tanks and flight refueling using Boeing's 'flying boom' pressure system from new KC-97A tanker aircraft. All-up weight was 83,915-90,718kg (185,000-200,000lb). The first B-47B flew on 26 April 1951 and the first 'Bs' entered service with the 306th Bomb Wing within a few months. The Korean War brought new orders for the B-47B, these covering a variant with 2630kg (5800lb st) J47-GE-23 turbojets in place of the earlier GE-11s with thrust ratings of only 2360kg (5200lb). Total production of the B-47B amounted to 399 aircraft, including some built by Douglas and Lockheed. The two outside manufacturers also produced examples of later B-47s, returning to a situation similar to that of 1943 when these companies built Boeing B-17s to speed production.

During the course of the next few years several B-47Bs were modified to fulfil other service or experimental roles. An experimental refueling tanker conversion produced the KB-47B, fitted with a British 'probe and drogue' system. Twenty-four became RB-47B high-altitude reconnaissance aircraft, each carrying eight cameras in a heated bomb-bay pack. The DB-47B was produced as the controller aircraft for the QB-47 pilotless drone, the latter being used to evaluate the vulnerability of air defenses. YDB-47B was the designation of the test aircraft for the Bell GAM-63 Rascal stand-off missile, first accepted in production form at the Pinecastle Air Force Base, Florida, in October 1957, but cancelled in the following year. More than 60 B-47Bs became TB-47B four-seat crew trainers.

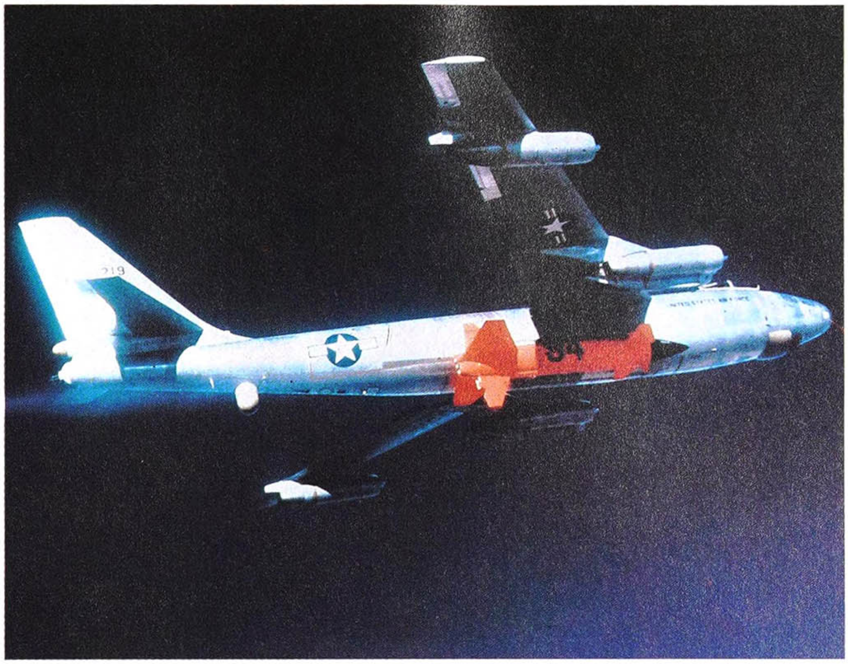
There was no 'C' version of the Stratojet as such, although the designation XB-47C related to a projected four-engined variant of the B-47 originally given the military designation B-56. This bomber was proposed originally with four J35 engines in order to reduce the high cost of the B-47, Allison YJ71-A-5s later being specified. The J71 was

Boeing RB-47E, one of the B-47Es produced for day and night long-range photographic reconnaissance.



a very new axial-flow turbojet with a 16 stage compressor and a three-stage turbine and could be operated in all weather conditions. It had a thrust of more then 4535kg (10,000lb) and eventually provided the power for the McDonnell Demon naval fighter, Martin SeaMaster and Douglas Destroyer. However, this bomber and its photographic reconnaissance derivative were cancelled before a prototype could be flown.

XB-47D referred to two B-47s modified to flight-test the Wright YT-49 turboshaft engines, each 10,380eshp engine driving Curtiss Turboelectric propellers with ducted spinners. The first XB-47D flew for the first time on 26 August 1955. Then came the all important 'E' model, the main production variant of the Stratojet. No fewer than 1590 were built, including the final 240 produced as RB-47E day and night photographic reconnaissance aircraft (the first RB-47E flew on 3 July 1953). The B-47E was powered by



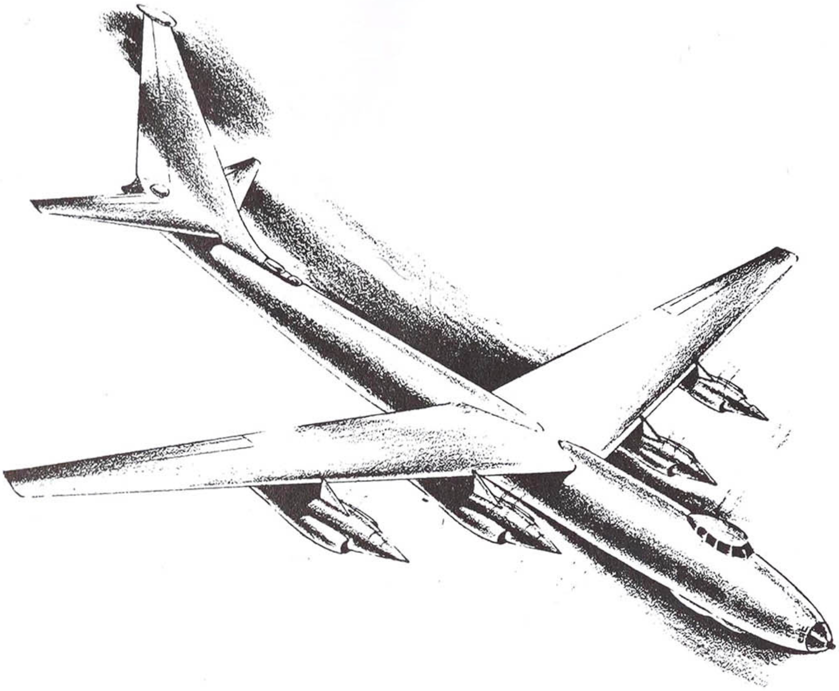
Above: One of four YDB-47Es used for the Bell GAM-63 Rascal stand-off missile development program.

six 3265kg (7200lb)st J47-GE-25 engines with water injection to increase power by 17 percent, carried flight refueling equipment and a new and more-powerful 33-rocket JATO pack that could be dropped after take-off, had a redesigned cockpit and substituted two 20mm cannon for the earlier guns. Such was the success of this refined and strengthened version – which had an all-up weight of 93,757kg (206,700lb), maximum speed of 975km/h (606mph) and range of 6438km (4000 miles) – that most B-47Bs were modified to this standard and redesignated B-47B-IIs. Eventually, a small number of B-47Es became photographic and weather reconnaissance aircraft, test aircraft for the Rascal program, special electronic communications types, and reconnaissance aircraft for searching out radar stations. The first B-47E flew on 30 January 1953.

In early 1957 production of the B-47 finally ended for Strategic Air Command. At about this time the B-47s in operational use were modified structurally to allow between six and ten more years of service. LABS (low altitude bombing system) or 'toss' bombing thereafter became an operational technique for delivering tactical nuclear weapons at low level, with the pilot pulling the aircraft up sharply before weapon release and then rolling away on a half loop. However, this maneuver was dropped from the B-47's tactical repertoire subsequently, although the bomber continued its combat role. The very last B-47s finally left the USAF in 1969, having served for the last three years in the passive role of weather reconnaissance.

Worthy of mention was Boeing's 1948 project for a long-range bomber derivative of the B-47. This bomber was to have had high-mounted wings with 21 degree sweepback, a span of 41m (135ft), length overall of 36.25m (118ft 11in), and a designed maximum take-off weight of 61,235kg (135,000lb). Maximum speed at 9150m (30,000ft) was estimated to be 789km/h (490mph), service ceiling 12,830m (42,100ft) and range 8585km (5333 miles). Bombload was to be between 4535-11,340kg (10,000-25,000lb). Selected powerplant was four Allison T40-A-2 turboprops driving Aeroproducts co-axial contra-rotating propellers, each with a rating of 5525shp. Although the XB-55 remained on the drawing board, the T40 powered several aircraft, including the Douglas A2D Skyshark and North American A2J attack aircraft, and the Convair P5Y flying-boat, none of which entered service. The engine had greater success with the later Tradewind flying-boat. Interestingly, Boeing's belief that very long range coupled with high performance could only be achieved by a bomber fitted with turboprop engines manifested itself again when the B-52 was conceived with turboprops. Similar thinking in the Soviet Union produced the Tupolev Tu-95 which, unlike the B-52, retained turboprops.

The final 1947 bomber built for the USAF had no direct connection with the XB-45,



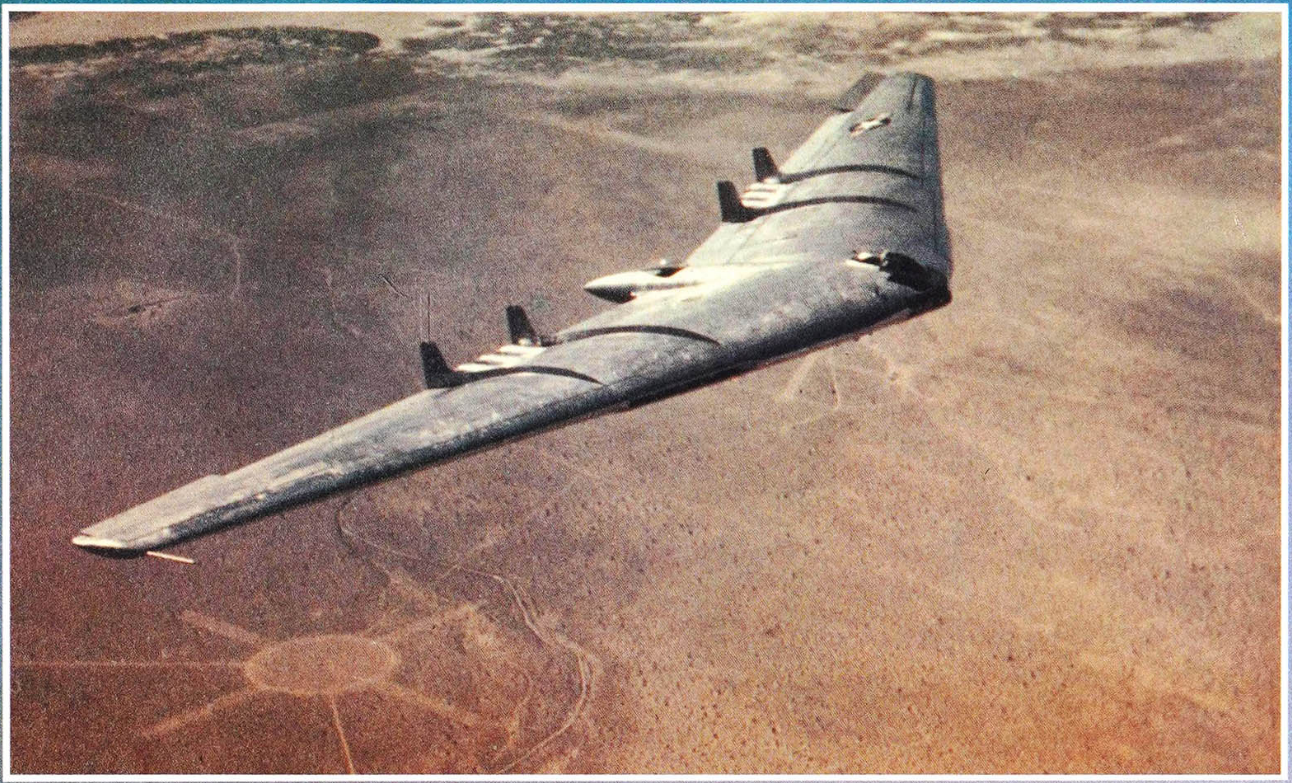
Artist's impression of the Boeing Model 474/XB-55.

XB-46, XB-47 and XB-48, not having been developed to fulfill the 1944 specification. In many ways the Northrop YB-49 was the most adventurous and, hard as it is to believe, very nearly became a service bomber. Indeed, it was probably the very radical configuration of the bomber as much as any other admitted reason that prevented its selection for large-scale use. The facts bear this out. In early 1949 one YB-49 flew a distance of 3634km (2258 miles) between Muroc Air Force Base, California, and Washington DC, averaging a speed during the flight of 822km/h (511mph). On another occasion, a YB-49 demonstrated a service ceiling in excess of 12,190m (40,000ft) during a flight lasting 9.5 hours. Such performance on the power of eight J35-A-19 turbojets was remarkable.

The YB-49 origins go back beyond the United States' entry in World War II. In 1940 Northrop flew its experimental N-1M flying-wing aircraft, a diminutive single-seater built to flight test the configuration for a projected transport aircraft. Flying-wing research was not unique to the United States, much work having been carried out in Germany, Britain and elsewhere. However, the work undertaken by Northrop was among the most successful and advanced and led the company to suggest to the USAAF a bomber based on the flying-wing concept. This was some three months before the attack on Pearl Harbor. With the outbreak of the Pacific War, the go-ahead was given for development. As a first step towards a production bomber, Northrop developed one-third scale flying models of the bomber to test the design and give pilots flying experience, these receiving the designation N-9M. Each was powered by two piston engines mounted as pushers.

The Northrop bomber was assigned the military designation XB-35. Interestingly the date of order, November 1941, was the same as that for the successful B-36. Both the XB-35 and XB-36 made use of Pratt & Whitney R-4360 Wasp Major piston engines driving pusher propellers, but the former required only four. When the XB-35 was completed in 1946 it presented to the world a most unusual sight. Here was a 52.43m (172ft) wing, constructed in the open in one piece from aluminum alloy. The chord at the centerline was an amazing 11.43m (37ft 6in), and the wing area was no less than 371.6sq m (4000sq ft). However, even these giant proportions were nothing when compared to those of the B-36, which appeared soon after. The crew comprised a pilot seated in the forward offset cockpit under a bubble canopy, a copilot, engineer, navigator, bombardier and gunner. Defensive armament was located in two four-gun turrets and four two-gun turrets spread above

The first of Northrop's amazing YB-49 jet-powered flying-wing bombers. Note the eight engines in groups of four.



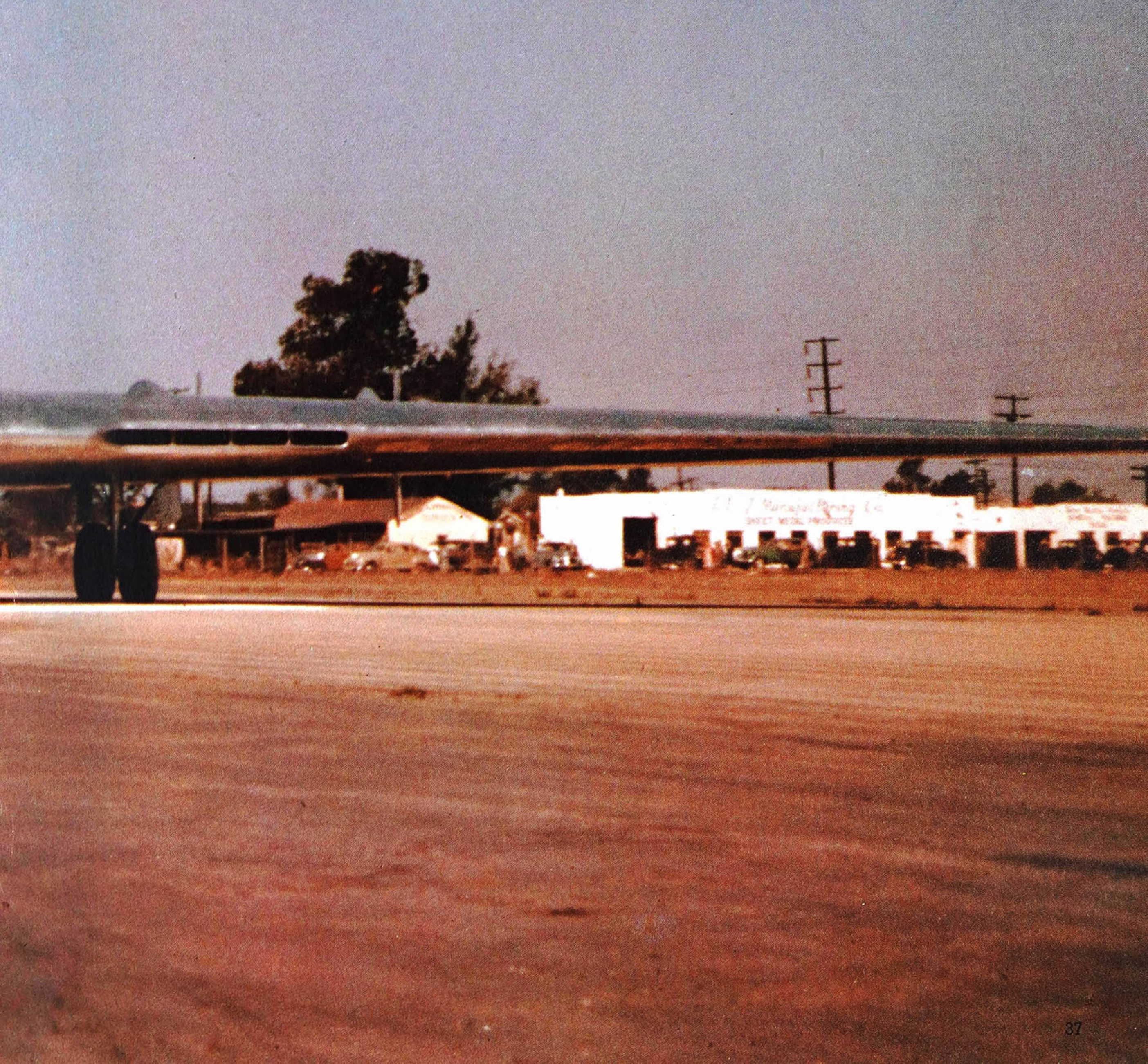
YB-49 in graceful flight.

and below the wing, controlled by the gunner from his cockpit in the rearward-protruding tail nacelle.

The XB-35 flew for the first time on 25 June 1946 and this was followed by an order for 13 YB-35 development and service test aircraft. However, the advantages of turbojet power for the flying-wing bombers were quickly realized and two YB-35s became YB-49 eight-jet prototypes. Of the remaining YB-35s, most are thought to have been considered for conversion to six-jet bombers, one to flight test Turbodyne turboprop engines and four to be cannibalized. In the event a six-jet version of the YB-35 did appear, but as the experimental YRB-49A reconnaissance-bomber. Such was the success of the YB-49s, the first having made its initial flight on 21 October 1947, that a production order for an initial batch of 30 B-49s was placed in the following year. But, for whatever reason, the whole batch of B-49s was cancelled in early 1949.

So ended the first-generation US jet bombers. North American and Boeing were contented with production orders for their B-45 Tornado and B-47 Stratojet, Convair, Douglas and Martin had to return empty handed to the drawing board (although each had other military and civil aircraft underway) and Northrop gave up the flying-wing with all its promise for more conventional configurations. One point was certain, while Britain was the first nation outside Germany to develop a successful jet fighter, when it came to jet bombers no nation on earth could equal the early impetus of the United States.

This good head-on view of a YB-49 shows the full span of the flying-wing bomber.



3: WITH A LITTLE HELP

During World War II Soviet combat aircraft production was based firmly on conventionally-configured and conventionally-powered fighters and bombers. Unlike Britain, Germany, Japan and the United States, the Soviet Union had not produced a jet fighter for production, although some piston-engined fighters had been boosted by auxiliary rocket motors. When it was announced in the Soviet Union, therefore, that one of its pilots had indeed engaged the Luftwaffe over Berlin in May 1945 while piloting a jet-propelled aircraft, it had to be considered whether this referred to a boosted conventional aircraft, a captured German jet or a hurriedly prepared experimental jet using turbojet engines under development by Arkhip Mikhailovich Lyulka. Initial experiments towards a turbojet engine by Lyulka had in fact begun in the late 1930s, but these had been forced to end with the outbreak of hostilities. An improved turbojet was bench-run in 1944 as the 1300kg (2866lb st) TR-1, but the type was not in production by the end of the war.

Meanwhile, when the war against Germany was in its last throes and Soviet forces moved into Germany itself from the east, several major factories and research establishments were taken over. Immediately technicians were sent in to study the projects being worked on, to send data and equipment back to the Soviet Union for evaluation, and subsequently to organize a temporary resumption of limited work for the benefit of the occupation forces. As well as the capture of several Junkers, Heinkel and other factories, Soviet forces took over the highly-secret research establishments at Peenemünde and Rechlin. The capture of vast amounts of technical data and working examples of several German turbojet and other engines were much prized, enabling early production in the Soviet Union of the Jumo 004B and BMW 003A for its MiG and Yak first-generation fighters. The Walter and Argus works were also captured, providing material on liquid-fueled rocket motors and ramjet engines respectively.

Soviet technicians were delighted to send home the unfinished Junkers Ju 287 prototypes. Much was expected of these. In 1946 many German scientists and technicians left Germany for the USSR, among them Junkers staff that went to Podberezhye to help with the completion of the Ju 287 with sweptback wings (project EF131). It is said that from this work were inspired a twin-turboprop bomber and other prototypes. Whatever benefit accrued from the completion of the Ju 287, it appears that few of the aircraft's innovations found their way into early Soviet bombers.

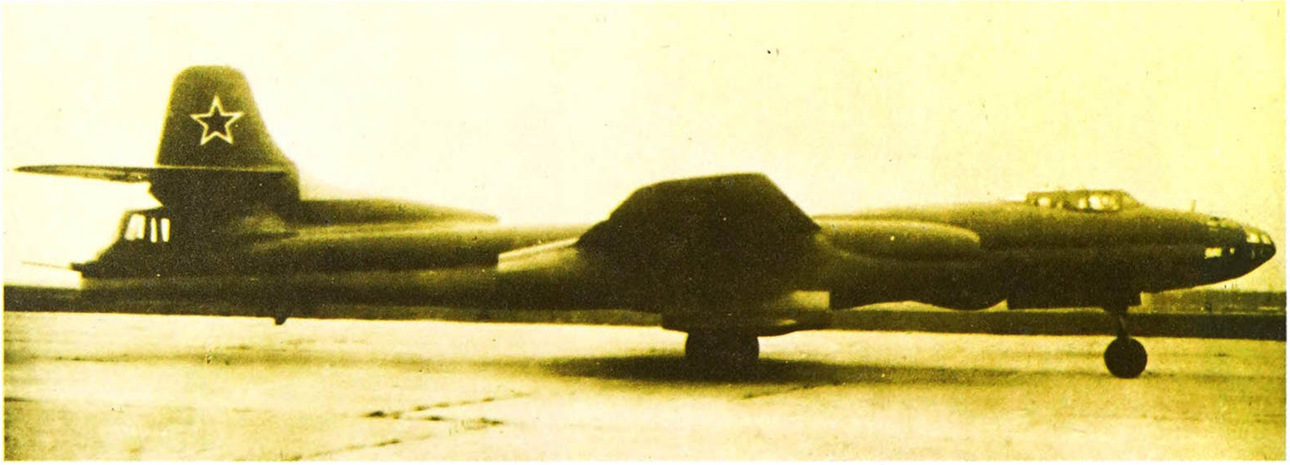
Perhaps the greatest boost to the development of Soviet jet aircraft came about in 1947, when Britain exported 25 of its well-proven Rolls-Royce Nene and 30 Derwent 5 turbojets to that nation. This export was sanctioned by the President of the Board of Trade, who set aside objections from the manufacturer and the Air Ministry. It was argued that the engines were not bound by security restrictions and thus could be exported. These engines were a great improvement over German types and allowed lengthy development of low-thrust turbojets in the Soviet Union to be bypassed. Nenes and Derwents found their way immediately into fighter and bomber prototypes, while both types were further developed and put into mass production as RD-45s (Nenes) and RD-500s (Derwents). Soon after import, the bureau, led by V Ya Klimov, was given the job of improving upon the RD-45, producing the very important VK-1 with a thrust rating of 2700kg (5952lb) compared to the Nene's 2268kg (5000lb st) in its original form.

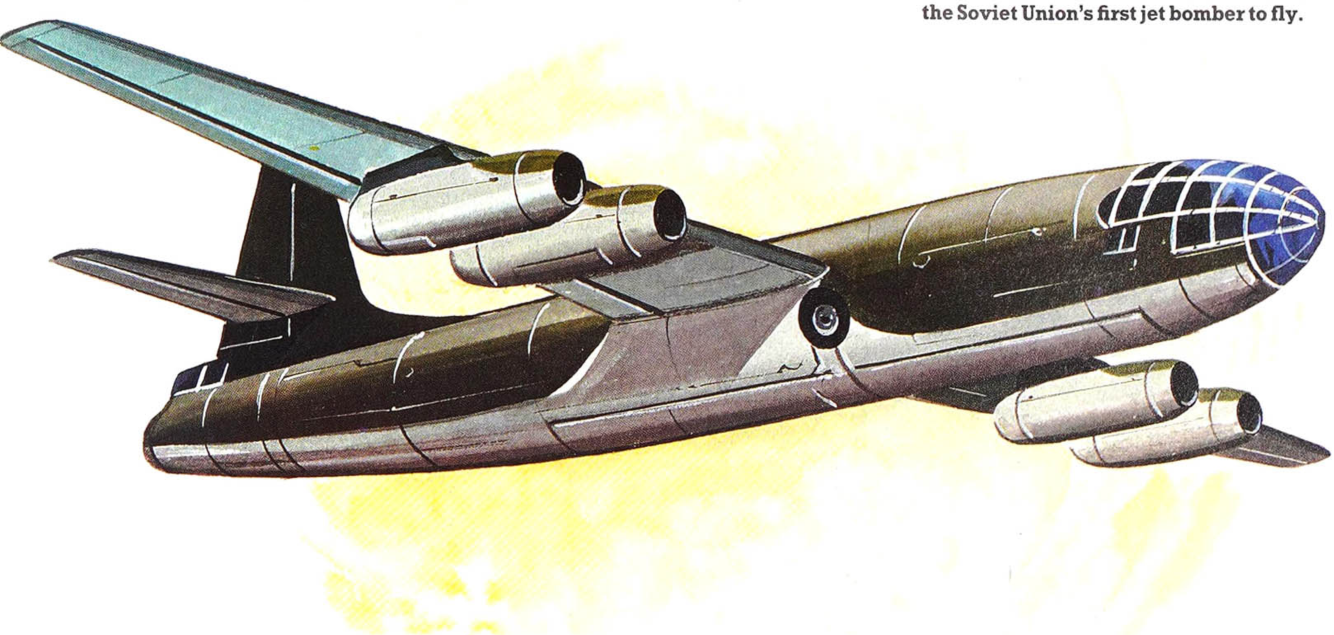
In 1946 it was reported that a four-engined jet bomber had been seen at Tushino, Moscow, during the Aviation Day display and flypast. Very little is known of this aircraft, which was clearly only experimental, but it was probably a reworked Petlyakov Pe-8. The 1947 May Day flypast included some 100 jet aircraft, but no jet bombers as such. Then on 3 August during the Aviation Day celebrations, new jet bomber prototypes were seen for the first time, including a four-engined bomber from Ilyushin and a smaller twin jet from Tupolev. Contemporary reports also suggest that the prototypes included a jet bomber from Sukhoi. What this could have been is not clear, although it appears most likely to have referred to either the first generation Su-9 or Su-11. The former was no more than a Soviet built Me 262 with RD-10 engines, while the Su-11 was developed from it as a ground-attack aircraft with TR-1 engines.

The honor of being the Soviet Union's first jet bomber to fly goes to the Ilyushin Il-22, it taking to the air for the first time on 24 July 1947. Constructed before the delivery of British turbojet engines, it was therefore powered by four TR-1 engines installed in forward-protruding underwing pods. Interestingly, the engines were not grouped in pairs as might have been expected because of German influence. The circular-

Previous page: The tactical support version of the Vautour was the II-A.

Tupolev's Tu-14 bomber operated by the Soviet Navy.





Artist's impression of the Ilyushin Il-22, the Soviet Union's first jet bomber to fly.

section fuselage was very much like that of the Tupolev Tu-4, itself a copy of the Boeing B-29 Superfortress. The most obvious difference was the newly-designed glazing, with a larger-area, unbroken panelled nose section and many more side windows. Close to the leading edges of the high-mounted tapering wings were the wells for the retracted units of the nosewheel-type undercarriage. The tail unit was conventional. Armament comprised up to 3000kg (6614lb) of bombs carried in the fuselage bay and a choice of two 23mm NS-23 cannon or 12.7mm Beresin machine-guns in both tail and dorsal turrets.

Only one Il-22 was built and this was not a success. However, in the sidelines was Ilyushin's Il-28. The other jet bomber to fly during the Aviation Day display of 1947, the Tupolev Tu-12, faired little better but was probably intended from the outset as an experimental design only. In fact the Tu-12, otherwise known as the Tu-77, first flew only three days after the Il-22. It seems unlikely that initial flights were made on the power of British Derwent engines, but certainly these were subsequently fitted in the very large nacelles which also housed the main units of the nosewheel-type undercarriage. The Tu-12 was obviously based on the piston-engined Tu-2, major changes being made only to the powerplant, undercarriage, and crew accommodation. Unlike the Il-22 with its crew of five, the Tu-12 had a crew of four comprising a pilot and navigator in a redesigned cockpit and two gunners to man the rear dorsal and ventral positions. The fuselage nose was both lengthened and slimmer than that of the standard Tu-2, with heavy glazing for the navigator who also acted as a bombardier.

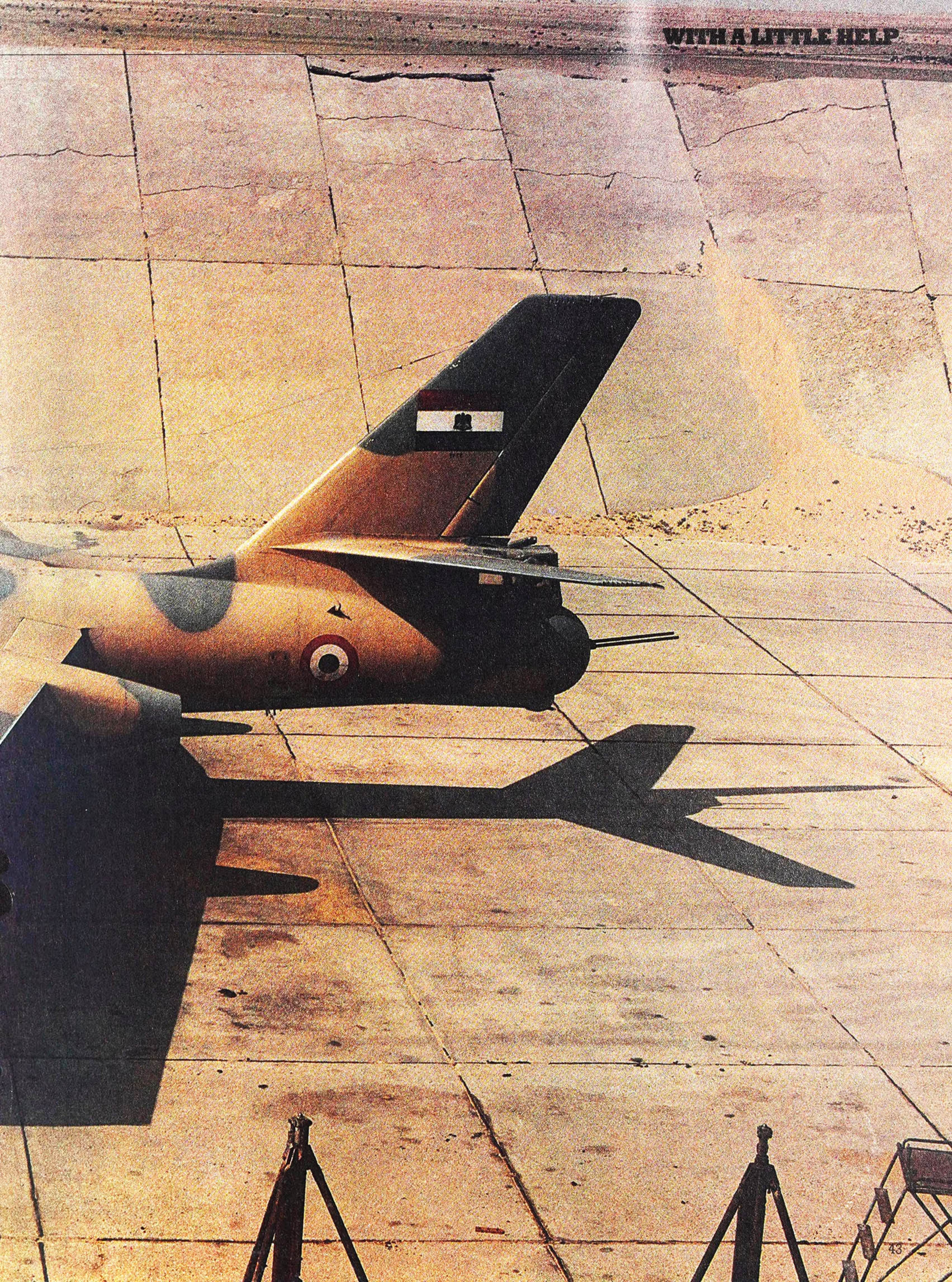
The Soviet requirement of 1946 for a jet-powered tactical bomber suited to operational service had still to be fulfilled and for this appeared three contenders. One was from the Sukhoi team and carried the designation Su-10. It was intended to have four Soviet-designed and built TR-1A turbojet engines, probably to be carried on mountings built out from the forward wing spar and grouped in pairs with one engine on top of the other. Each upper engine was positioned well back from the lower. Interestingly, while the tailplane was unswept but tapered, the vertical tail was heavily swept. Work on the prototype continued until 1948, when the aircraft was abandoned. The reason for this is not clear but might have been influenced at least by Stalin's personal preference for the Ilyushin Il-28.

In fact it was not the Ilyushin bomber that first appeared in prototype form and there has been some confusion as to whether the Tu-14 or the Il-28 was the first jet bomber to enter service with the Soviet forces. While it is clear that the Tu-14 was the first jet bomber to be used by Soviet Naval Aviation, the Il-28 first went to the Air Force. A clue to the timing is in the state acceptance trials. Those for the Il-28 were completed in early 1949, whereas the Tu-14 trials ended later. Also, no fewer than 25 early examples of the Il-28 took part in the 1950 May Day flypast led by Lt Col A. Anpilov, all probably production aircraft.

In 1946 preliminary design of a jet bomber to compete with the Su-10 and Il-28 was initiated at the Tupolev bureau. This allowed for turbojet engines in nacelles at the extremities of the wing center-section. With the arrival of British Nene and Derwent engines in the Soviet Union, this design was radically changed to produce the follow-on Type 73. This had Nene engines in underwing nacelles and a Derwent in the tail, an air intake for the latter being incorporated into the long extension to the low-aspect-ratio, rounded fin. The wings were unswept and tapered, but the tailplane was given considerable sweepback. The mainwheels of the nosewheel-type undercarriage retracted into the nacelles. In the cockpit under a raised hood sat the pilot and radio operator in typical Shturmovik fashion, with the radio operator facing rearwards to aim and fire the remote dorsal cannon. The navigator's compartment was in the glazed nose and the rear-gunner occupied a cabin under the tailfin extension to operate the two remotely-controlled ventral cannon. In the nose of the bomber was a fixed cannon.

The type 73 took off for its first flight in October 1947 and was tested at the works for nearly eight months. Meanwhile, a second prototype joined the Tu-73, under

Ilyushin Il-28 *Beagle*, one of five operated by the Egyptian Air Force.



the designation Tu-78. Despite some minor changes to the configuration, this aircraft was important primarily as it flew with Soviet-built RD-45 and RD-500 Nene/Derwent derivative engines. Such was the reliability and power of these, that it was considered unnecessary to retain the tail-mounted Derwent for production bombers. It was, indeed, the continual reappraisal of the design that lost Tupolev the lead over Ilyushin for the honor of producing the Soviet Union's first production jet bomber. The tail-mounted engine was duly removed on a new prototype, allowing for a conventionally-operated defensive system of twin Nudelman-Richter NR-23 cannon in a lengthened tail, while the dorsal cannon were removed and the nose armament doubled. The rear-gunner's cabin became the accommodation for the bombardier. Externally the most recognizable change was to the vertical tail, which became more angular. As the Tu-81, the aircraft was accepted for production and became a naval attack bomber for shore-based duties, carrying the new designation Tu-14.

Several versions of the TU-14 were produced, the most important being the Tu-14T, carrying up to 3000kg (6614lb) of bombs or two torpedoes. Most Tu-14s, which received the NATO reporting name *Bosun,* were powered by two VK-1 engines. Maximum speed at height was 845km/h (525mph) and maximum range with a light warload was a little over 3000km (1865 miles). It is not known how many Tu-14s were built for the Soviet Navy, but it is likely to have been a comparatively small number. These served throughout most of the 1950s and into the next decade. The Tu-14 also failed to win the international acceptance that greeted the Il-28.

In March 1952 Andrei Tupolev and 13 members of his design bureau received a Stalin Prize of 150,000 roubles, undoubtedly for their major contributions to the development of jet bombers. A similar prize was awarded to Sergei Ilyushin and 10 of his team, prompted by the success of the Il-28.

It is true to say that the Ilyushin Il-28, known to NATO as *Beagle* in its combat form, was one of the most successful jet bombers ever built. It was undoubtedly built in the greatest numbers, had the longest production run and was the most widely operated. In the early 1980s it was still in production in China as the Harbin B-5, carrying the Chinese name Sinshi-wu Houng-chai Chi. It is believed that the Air Force of the People's Liberation Army has 300-450 Il-28 bombers in operational use, some assigned the task of delivering nuclear weapons, while the People's Navy is thought to have 100-150. How many of these are Chinese-produced and how many are surviving aircraft from the 500 or thereabouts delivered to China from the Soviet Union prior to the political breakup is not clear. At least 19 other countries outside the USSR received Soviet or Czech-built Il-28s at one time or another. These have included Afghanistan, which still had some 20 in 1981; Algeria, with about 24; Bulgaria, no longer used; Cuba, no longer used; Czechoslovakia, which put the Il-28 into production as the B-228 but no longer uses them; Egypt, a small number remaining; Democratic Republic of Germany, no longer used; Finland, two still in use as target tugs; Hungary, still operational but the number unknown; Indonesia, no longer used; North Korea, about 60 bombers plus trainers in use; Iraq, some 10 trainers in use; Nigeria; Poland, a few remaining for reconnaissance and electronic countermeasures roles; Romania, a few remaining for reconnaissance role; Somalia, a small number of bombers; Syria, about 10 for attack; Vietnam, a few bombers; North Yemen, a handful of bombers; and South Yemen with some 12 bombers. Chinese B-5s have also been exported, Albania receiving 10. The Soviet forces no longer operate Il-28s.

As mentioned earlier, the Il-28 was designed to a 1946 requirement for a light tactical bomber and was regarded very favorably by officials and Stalin alike. Indeed, in 1947 Stalin ordered high priority for its development and subsequently ordered that it should take part in the May 1950 fly-past. Three prototypes were built, the first taking to the air initially on 8 August 1948. On the power of two RD-45 turbojets carried in underwing pods common to the Tu-12 and Tu-14, it demonstrated a maximum speed of 833km/h (567mph). However, this was reduced by nearly 80km/h (50mph)

Yakovlev Yak-28.

when operational equipment and armament were added.

Early series-built Il-28s had RD-45FA turbojets rated at 2740kg (6041lb)st. Subsequently the VK-1 and later versions of this engine were fitted, including the 2700kg (5952lb)st VK-1A. The Il-28 is a three-seat bomber, its shoulder-mounted wings having straight leading edges and tapered trailing edges. Construction is mostly of D16-T duralumin. The circular-section semi-monocoque fuselage has a glazed nose with an optically-flat panel for bomb aiming. This task is undertaken by the navigator, who is seated on an ejection seat in a cabin below and forward of the pilot's cockpit. It is the pilot who fires the twin NR-23 cannon that are carried in a fixed position in the lower fuselage. The radio operator also has control of the two NR-23 tail-guns, each with 225 rounds of ammunition, which are carried on a Il-K6 mounting.

The radio operator has no ejection seat, having to use the entry hatch under the rear fuselage for an emergency escape. Maximum warload carried in the internal weapons bay is 3000kg (6614lb), but like the Tu-14 the usual load was designed to be just 1000kg (2206lb) or perhaps four 500kg or eight 250kg bombs. Unlike the Tu-14, both the vertical and horizontal tail surfaces are swept, at 45 degrees and 33 degrees respectively, but the undercarriage was designed to be similar, with the main units retracting into the engine nacelles. At a normal take-off weight of 18,400kg (40,565lb), the Il-28 with VK-1A turbojets has a maximum speed of 902km/h (560mph) at 4500m (14,760ft). Range is up to 2400km (1490 miles) when flown at low speed and high altitude at the maximum take-off weight of 21,200kg (46,738lb).

Apart from the Chinese and Czech-built versions of the Il-28, the basic versions built have been the standard Il-28, which first entered service Soviet air force units in about 1950; the Il-28R reconnaissance variant, with tip-tanks as standard to increase range and endurance and carrying three, four or five cameras and flares or photoflash bombs in the bomb bay; and the Il-28T naval version carrying one or two torpedoes, depth charges or mines. The Il-28U is a training version with the bomb-aiming glazed panels and cannon removed and a second heavily-glazed but lower cockpit with dual controls installed in the forward fuselage. Also deleted is the PSB-N ground-mapping and blind-bombing radar housed in the underfuselage blister just aft of the nosewheel doors. ECM (electronic countermeasures) and other specialized variants of the Il-28 were completed by modification of standard types. Worthy of mention also is the Il-20, a specially-prepared civil version of the Il-28, used by Aeroflot briefly from 1956 to carry various cargoes associated with newspaper production between major cities.

The first swept-wing bomber to originate in the Soviet Union was the Tu-82, an experimental aircraft both smaller and lighter than the Tu-14 but considerably faster. It appeared in 1949 but was not selected for production. Ilyushin's first bomber with swept wings was the experimental Il-30, a very high-speed aircraft from which was evolved the Il-54. Capable of a speed of more than Mach 0.9, the Il-54 began testing in 1954, but this too remained experimental. However, so sure were officials in the West that the Il-54 was destined for operational service, that it was assigned the NATO reporting name *Blowlamp*.

While the West was awaiting the first signs of *Blowlamp* in operational service, inside the Soviet Union plans were taking a different course. There was little doubt that the Il-54 was a formidable light tactical bomber, possessing a maximum speed more than 240km/h (150mph) higher than that of the standard Il-28 in service, although range was a matter for concern. Power was provided by two 6500kg (14,330lb)st Lyulka AL-7 turbojets, the first such engine having been bench run only in 1952 and the first production examples given flight clearance in 1954. In fact the Il-54 was the AL-7's first application, although soon afterwards it was installed in early examples of the Sukhoi Su-7, which in production form was the aircraft destined to replace most Il-28s. If proof was needed by 1961 that *Blowlamp* had not achieved operational status, it came with its absence from the Aviation Day flypast and the inclusion of new prototypes described as supersonic multi-purpose aircraft. These were prototypes of the Yak-28, which had flown for the first time the previous year.

Known to NATO as *Brewer*, the Yak-28 went into Soviet air force service from 1963, by which time more than a decade had passed since the first of the projected Il-28 replacements had flown. This time lapse was due more to the excellence of the Il-28 and the development of a single-engined ground-attack fighter (the Su-7) that could perform many of the Il-28's tasks, than to any inability to produce a multi-engined replacement of the necessary caliber. Indeed, it was widely accepted in the mid-1950s that *Beagle* was perhaps the most formidable tactical bomber in the world.

Brewer was produced in three attack versions, each accommodating the pilot in a fighter-type cockpit under a blister canopy and the navigator/bomb-aimer in the glazed nose. Power was provided by two 5950kg (13,117lb)st Tumansky R-11 turbojets with afterburning, a widely used engine that had entered production in 1956. These were installed in very long underwing nacelles, the wings themselves being swept back at 45 degrees. The semi-monocoque fuselage and swept tail surfaces were designed to be conventional, but the undercarriage was not, having tandem twin-wheel main units under the fuselage and small balance wheels near the wingtips. Interestingly, this type of undercarriage arrangement had previously been seen on *Blowlamp*.

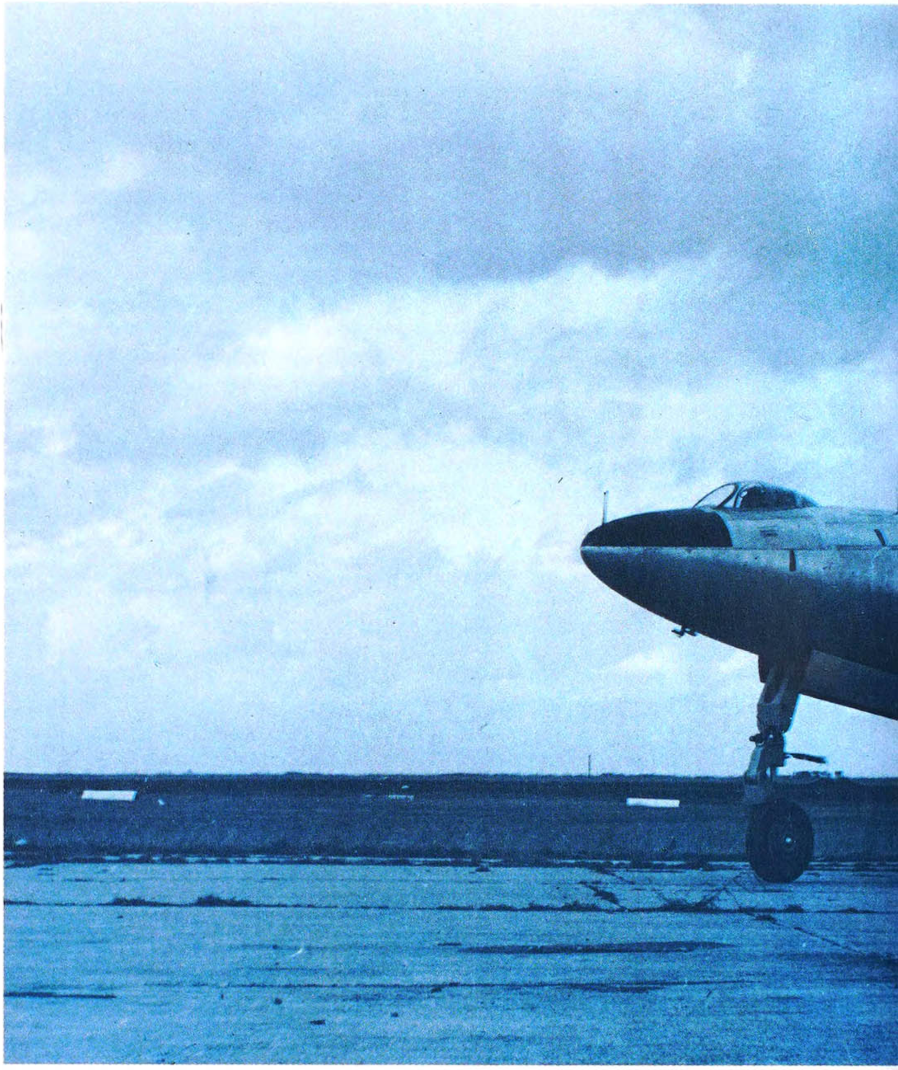
The first production version was known to NATO as *Brewer-A* and was the most basic. It carried one fixed 30mm NR-30 cannon in the forward fuselage, light weapons on underwing pylons and bombs (usually

two 500kg) or nuclear weapons in the bomb bay positioned between the main undercarriage units. A pylon under each wing outboard of the engine usually carried a pointed slipper-type auxiliary fuel tank to increase range.

The next version was *Brewer-B*, a generally similar aircraft that probably became operational very soon after *Brewer-A*. The main refinement was the addition of a ventral blister radome under the fuselage forward of the wings, which housed the navigation and blind-bombing radar. This was followed by the final attack version as *Brewer-C*. This was easily identifiable by its slightly longer fuselage, lengthened engine nacelles that extended forward to a point level with the radome and long wingtip probes. Cannon armament was increased to two in the forward fuselage.

By the early 1980s most *Brewer* attack aircraft had been withdrawn from front-line duties to serve in support capacities, their light warload, transonic maximum speed and probable maximum range of no more than 1850km (1150 miles) making them unsuited to service with the modern Soviet air force. However, some 200 *Brewer-D* reconnaissance aircraft with cameras in the bomb-bay and 40 *Brewer-E* electronic countermeasures aircraft are deployed. *Brewer-E* is of particular interest as it was the first Soviet aircraft deployed as an ECM escort, having entered service in 1970. This variant also has provision for carrying rocket pods outboard of the auxiliary slipper tanks. The Yak-28P two-seat, all-weather fighter was also derived from *Brewer* attack aircraft and is known to NATO under the reporting name *Firebar*. Up to 300 serve today in air defense units, having been operational for close-on two decades. The designation Yak-28U applies to a tandem cockpit trainer for *Firebar* pilots, known to NATO as *Maestro*.

Another country that benefited from the British Rolls-Royce Nene engine was France, whose own engine manufacturers were not able to produce turbojets of this caliber for some years after the war. This is not to say that French companies had been slow to grasp the importance of the turbojet as a powerplant for aircraft. Far from it. The Société Rateau had started experimenting in this field as early as 1939, but the German occupation of France ended any real hope of major advances. However, small groups of the company's engineers worked continuously during this period, allowing clandestine achievements to be co-ordinated postwar and the SRA-1 axial-flow turbojet engine to be built. By early 1947 the engine had completed acceptance trials but was clearly not in the same class as turbojets being produced abroad. Work thereafter began on the SRA-101 10-stage axial-flow engine, with a static thrust of 4000kg (8820lb), in collaboration with SNECMA.

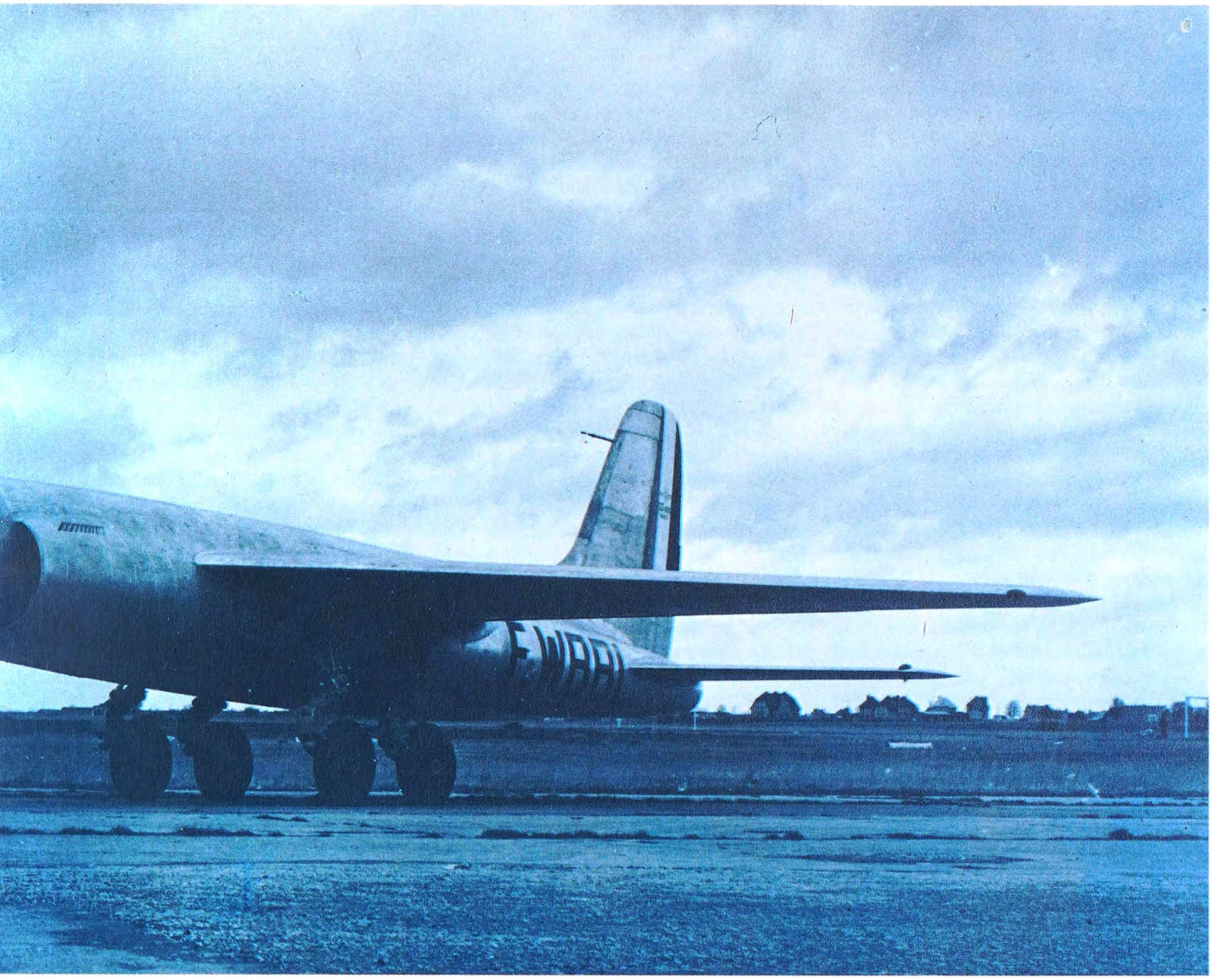


The French Sud-Ouest SO 4000 high-performance bomber carrying a civil registration.

Another company that continued work on gas turbine engines while under German authority was SOCEMA, who in fact managed fairly open development of a turboshaft engine by adopting the pretense of working on an engine for a train. This deception was aided by the choice of designation for the engine, TGA 1 assuming to stand for Turbo-Groupe d'Autorail and its development being under contract from the French railway authority.

In the long term it was the work started by Aeroplanes G Voisin, Groupe Technique, which had the major effect on later French jet aircraft design. This group took over the design department of Atelier Technique Aéronautique Reichenbach after the war, the company itself having previously been engaged in the manufacture of BMW engines at its Lake Constance plant. Work was swift and soon the ATAR 101 seven-stage, axial-flow turbojet had been developed in prototype form, the actual construction of the engine being the responsibility of SNECMA. Testing began on 11 May 1948 at Paris and early flight trials were conducted using a Martin B-26 Marauder.

As mentioned previously, Hispano-Suiza began the production of turbojet engines following the receipt of licenses from Rolls-Royce covering the Nene and Tay. The license for the Nene was granted in 1946, as a result of which several prototype jet aircraft were rapidly completed. However, it should not be forgotten that early experi-



ments in France included those with jet aircraft powered by German engines, the Arsenal VG 70 single-seat research aircraft being an example. Using French-built Nenes, the Aérocentre NC 1071 became the first French multi-jet aircraft to fly, taking off for the first time on 12 October 1948. Designed as a carrier-borne trainer for the French Navy, it had been projected also for torpedo and dive-bomber roles.

The NC 1071 was an interesting design, with its crew of two or three occupying a central nacelle and two very large outer nacelles housing the engines and also supporting the tail unit with twin fin and rudder and a linking horizontal surface. The mainwheels of the nosewheel undercarriage retracted into the engine nacelles and the offset nosewheel into the central nacelle. The wings were unswept and tapered. Maximum take-off weight was reported to be 11,450kg (25,240lb) and maximum speed 792km/h (492mph). Although an important design in respect of its powerplant, it was one of the casualties of the company's voluntary liquidation in 1949. A twin-jet bomber designated NC 270, was designed to achieve a speed of Mach 0.88 on the power of Nenes and had swept wings and tail surfaces. It too was a casualty of the liquidation when the prototype was 85 percent complete.

Interestingly, prior to the start of construction of the NC 270 jet bomber prototype, Aérocentre had built and flown two scale flying models as NC 271s. The first was flown as a glider to test the general configuration, but the second was powered by a Walter rocket motor housed in the fuselage. The glider was first released from an SE 161 Languedoc 'motherplane' on 28 January 1949, only a few months before the company ended trading.

A similar approach was adopted by SNCASO, a company best remembered simply as Sud-Ouest, which projected a twin-jet, high-performance bomber using the French-built Nene, covered under the designation SO 4000. This was a fairly simple design, although it incorporated a sufficient number of innovations to warrant initial flight trials with half-scale models. The SO 4000 was designed to accommodate a crew of two under a fighter-type canopy high in the nose of the long and deep cigar-shaped fuselage. Forward of the swept back wings were air intakes for the Nene engines that were positioned side-by-side in the rear fuselage. The tail unit was conventional except for the low position and sweep of the tailplane, but the undercarriage was another matter entirely. This used a very long nosewheel and four individual mainwheels in tandem pairs that retracted into the wing roots.

The first half-scale model was the SO M1 glider. This was followed by the M2, expected to research high-speed flight and for this purpose carried a Rolls-Royce Der-

went in the rear fuselage. Take-off was achieved on 13 April 1949 and in the following year M2 became the first French aircraft to exceed a speed of 1000km/h in level flight. It had thick-skinned, laminar-flow wings, swept at 31 degrees and with wide trailing-edge flaps. Small ailerons connected with spoilers for lateral control and leading-edge slots were incorporated.

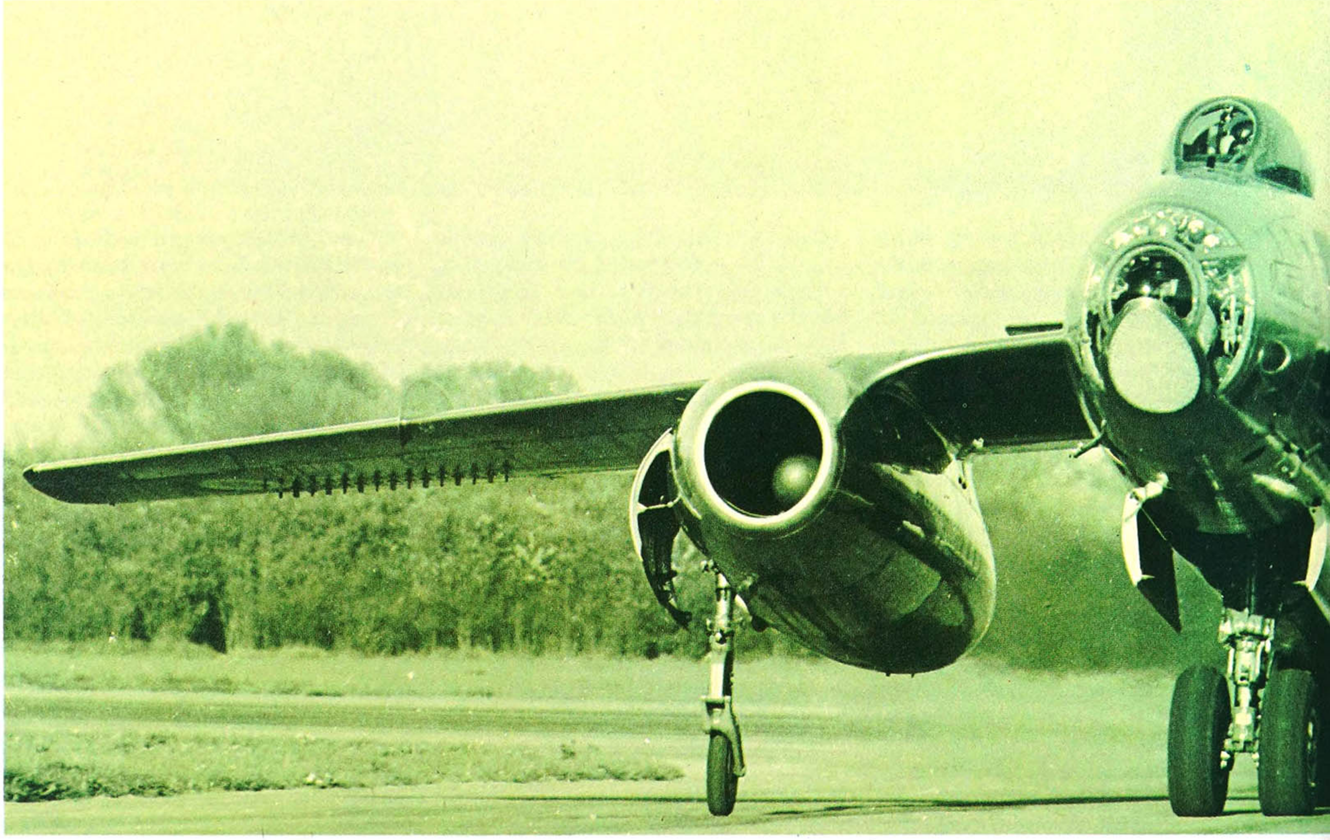
One of the main functions of the M2 had been to flight-test control systems at high altitude and at high subsonic speeds. When this was achieved the SO 4000 prototype was completed and flown for the first time on 15 March 1951. A cruising speed of 830km/h (516mph) was estimated for the bomber, but it was soon after abandoned.

Even at this early stage it had become quite clear that the SO 4000 was not an advanced design, despite its swept wings and tailplane. A glance at aircraft appearing in Britain, the US and the Soviet Union was testament to this. However, in the sidelines was a new aircraft from Sud-Ouest, although it is better remembered as a Sud-Aviation type following the amalgamation of Sud-Ouest and Sud-Est (SNCASO and SNCASE) in March 1957. This was the SO 4050 Vautour, a high-performance 'Jack of all trades.' Said to have derived from the SO 4000, there is little evidence of this from a cursory glance at the two aircraft, although no doubt much of the research data gained from the SO M2/SO 4000 program was useful to the SO 4050 project.

The SO 4050 was among the first aircraft to have Atar 101 engines installed, marking the coming-of-age of the French-developed turbojet. Indeed the Atar in various models has powered all operational French jet fighters and bombers since the Vautour, although the very latest combat aircraft of French origin have turned to turbofans. The Vautour was conceived to fulfill three main roles, namely tactical support (fighter-bomber), bomber and all-weather fighter. The first of three prototypes took to the air for the first time on 16 October 1952 on the power of two Atar 101Bs. This aircraft was subsequently re-engined with Atar 101Cs. The second prototype did not fly until 16 December 1953, using Atar 101Ds followed nearly a year later by the third prototype with Armstrong Siddeley Sapphire 6 engines. These prototypes were the fighter, tactical support and bomber variants respectively. Also in 1953 the French government ordered six preproduction aircraft. The first was the two-seat bomber fitted with afterburning Atar engines, which became the property of the air force on 25 March 1955. The next two preproduction Vautours were single-seat tactical support types, followed by three two-seat fighters, the last powered by Rolls-Royce Avon turbojet engines was flown in October 1955.

When the production Vautour was ordered for the French air force, the initial request for 140 was expected to be only the first, a total strength of 360 then being envisaged. However, 140 remained the total number built, comprising 30 Vautour II-A tactical support aircraft, 40 II-B bombers and 70 II-N fighters. The first to enter service was the II-A in 1956. By early 1959 all of this version, 25 of the II-Bs and half the II-Ns had been delivered. In the following year six II-Bs were acquired from France by Israel, as well as all but five of the II-As. All production Vautours were powered by Atar 101E-3 engines, each rated at 3500kg (7716lb)st.

The Vautour represented several 'firsts,' apart from those connected with its configuration. These included the SO 4050-01 becoming the first French twin-jet to break the sound barrier (while in a shallow dive), and in January 1958 one Vautour became the



first French jet to be refueled in the air. The tanker for this experiment was an English Electric Canberra.

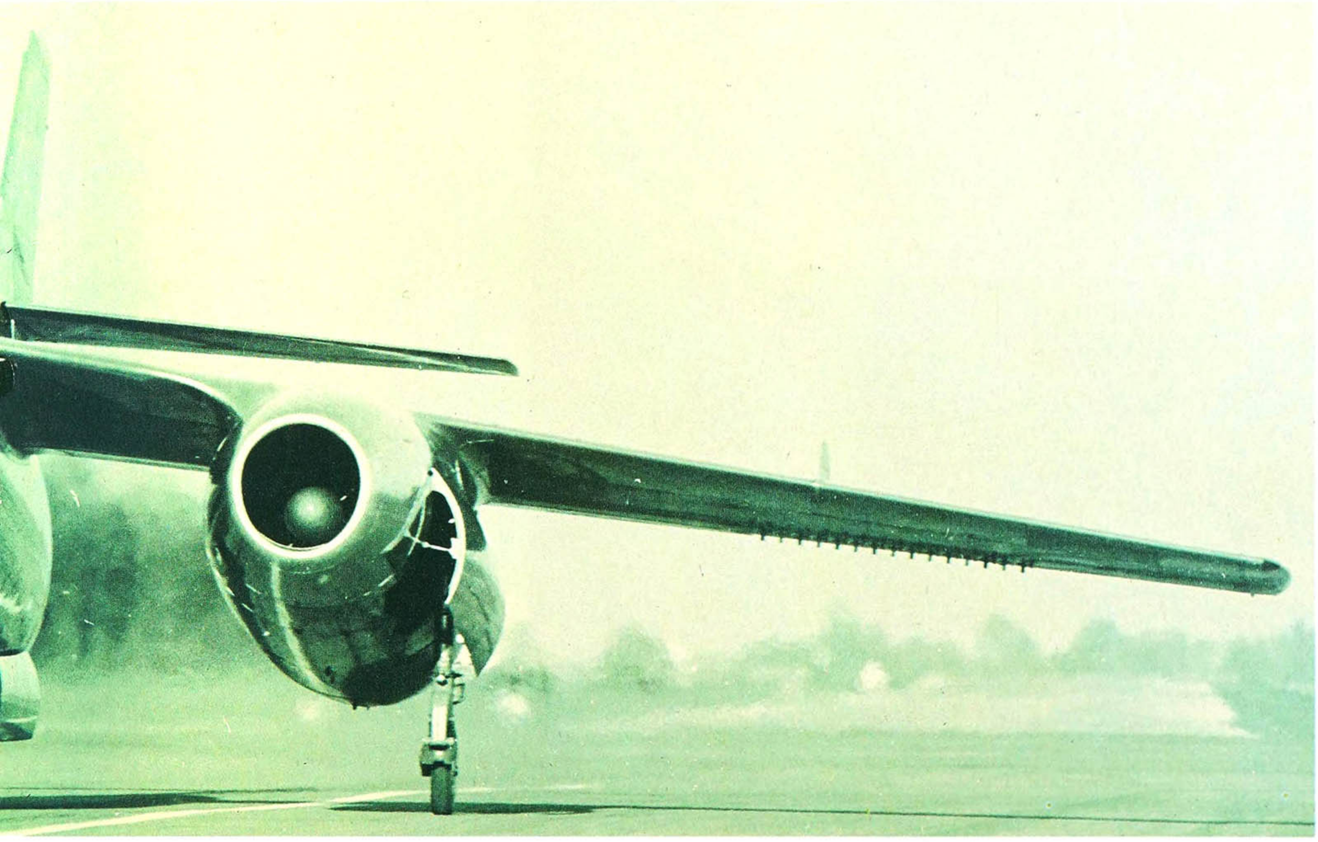
The Vautour itself was a rather beautiful mid-wing combat aircraft, with thirty-five degrees of sweepback on its wings. Vortex generators (known also as turbulators) were positioned forward of the ailerons to increase the relative speed of the boundary layer and hold it. The turbojet engines were carried under the wings in long nacelles, which also housed the small balancer wheels of the undercarriage that retracted into the outboard sides. Main undercarriage units comprised tandem twin-wheels, retracting fore and aft of the bomb bay. A ribbon-type braking parachute was carried in the rear fuselage. An all-moving swept tailplane and swept fin and rudder comprised the tail unit, although a small rounded ventral fin was incorporated under the extreme end on the fuselage to protect the engine nacelles and nozzles on take off.

Accommodation varied according to role. The II-A had a pilot only in a pressurized cockpit sitting on an ejection seat. The II-B and II-N were both two-seaters with pressurization and ejection seats, the former with a pilot under a II-A type canopy and a bomb-aimer in a nose compartment with glazed panels, who entered via a hatch forward of the pilot's canopy, and the latter with the crew in tandem under a long canopy. As with accommodation, armament varied, the II-A carrying four 30mm DEFA cannon in the nose (each with 100 rounds of ammunition), either drop tanks, four Matra rocket packs (19 rockets in each), two 450kg bombs or a total of 24 120mm rockets under the wings, and up to 10 bombs or 232 SNEB rockets in packs in the bay. The II-B's armament was similar but without the cannon, while the II-N fighter had the cannon, provision for the bomb-bay rockets and underwing stores that included the drop tanks or Matra rocket packs of previous versions, or four Matra R 511 air-to-air missiles. An automatic search and tracking fire-control radar developed by CSF was installed in the fighter. Maximum weight of the Vautour was 20,700kg (45,635lb), maximum speed 1100km/h (684mph) and range 4000km (2485 miles).

Sud-Est produced several very interesting experimental aircraft in the late 1940s and early 1950s. One such aircraft was the Grognard, a high-speed, ground-attack jet with a peculiar 'humped back.' The fuselage shape resulted from the decision to position the air intake for the two French-built Nene turbojets aft of the pilot's cockpit, the engines themselves staggered one above the other in the deep fuselage. Other notable design features were swept back wings, a very low-mounted tailplane, and a heavily-glazed cockpit for the pilot.

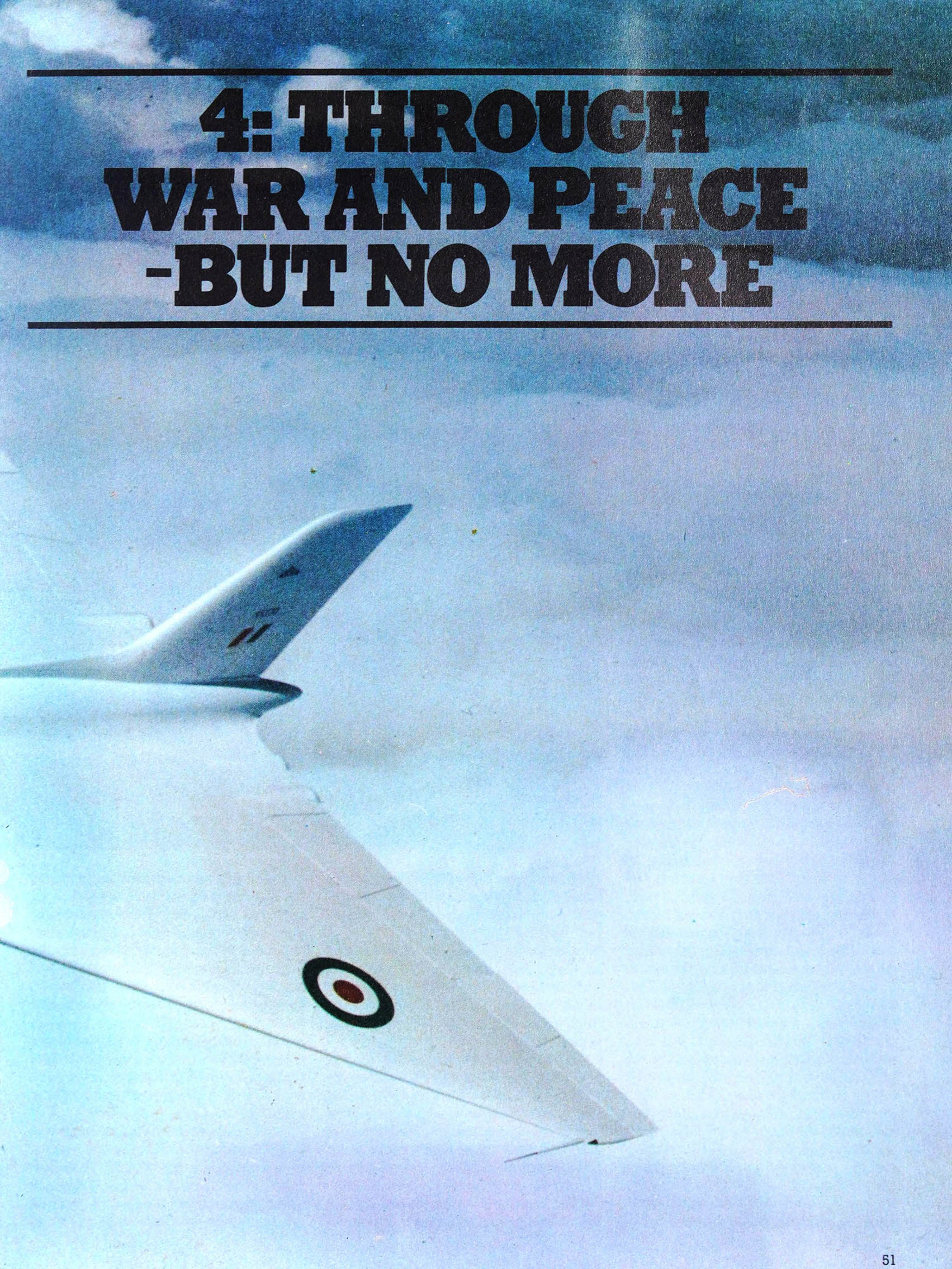
The original prototype was known as the SE 2410 Grognard I. This flew for the first time on 30 April 1950. Maximum take-off weight was 14,500kg (31,967lb) and maximum speed an impressive 1037km/h (645mph) at 1500m (4920ft) altitude. Armament was expected to include cannon, rockets and bombs. In the event neither this aircraft, nor the two-seat SE 2415 Grognard II derivative that flew in the following year, achieved production status. Instead, both served as test aircraft for various weapons then under development.

Only one French bomber, the Mirage IV, has entered service since the Vautour II-B. All bombing roles, with the exception of strategic bombing, have been taken over by fighter-bombers.



The French Vautour II-B bomber, identifiable by its glazed nose.

4: THROUGH WAR AND PEACE -BUT NO MORE



In May 1982, an RAF Vulcan B.Mk 2 Bomber operating temporarily from Ascension Island carried out an attack at night on the Argentinian-controlled airfield at Port Stanley, Falkland Islands. Its load had been 21 1000lb bombs and its purpose to render the runway unusable by large transport aircraft. This was the first of three such attacks by Vulcans. On another two raids Vulcans carrying antiradiation missiles fired from hastily-fitted pylons attacked early warning and ground defense radars. Each raid meant a mission length of up to 16 hours and inflight refueling from Victor tankers.

Apart from their historical importance, the missions were undoubtedly at the longest range ever attempted by an air force. The eventual outcome of the conflict in the South Atlantic is now history, but these raids were carried out by aircraft of a condemned species. The last bombers of Britain's once proud V-bomber force, these aircraft had been scheduled for retirement within weeks of the conflict, half the Vulcan force having already been phased out. The fact that the remaining Vulcans could be made ready for combat and their crews prepared for such missions at this eleventh hour is remarkable enough, yet equally impressive was the speed at which new weapon systems were fitted for specialized missions and crews trained.

That an aircraft whose origins date back to 1952 should be ready for retirement cannot be in doubt, yet Britain has not developed or purchased from the United States a modern replacement. Ever since the Royal Navy began deployment of Polaris submarines, the role of the medium and strategic bomber in Britain's defenses has been run down. This process came to a head in the 1970s when forward planning clearly had no place for a manned bomber in the RAF able to strike at the strategic military and industrial targets of a potential enemy. While many argue that the threat of mutual destruction of homelands by land-based (of which Britain has none) and sea-based nuclear weapons is sufficient to prevent world war, the Falklands and other world issues have highlighted another side of military readiness. Unless planners can be sure that nuclear weapons on land or in the sea are capable of preventing all wars, and clearly they are not, it can be argued that there must be a place for manned aircraft that can not only attack invading forces but can strike at the centers of military build-up, communications and production and not necessarily with weapons of mass destruction. Only the bomber can offer the instant choice of carrying conventional or nuclear weapons.

Previous page: Prototype Avro Vulcan with straight wing leading edges.

Avro Lancaster flight testing a British turbojet engine carried in the modified tail.

It was during World War I that Britain first discovered the importance of not only holding the front line but crippling the military production of the enemy. Only by holding up the development of new weapons and then their manufacture and deployment, could planners be sure of weakening the enemy's capacity to fight. Hastily-modified service aircraft were assigned the first strategic bombing missions, filling the gap until purpose-designed heavy bombers became available for operation.

During World War II it was the strategic bomber that carried the war beyond occupied countries and to the homeland of the aggressor, preventing greater numbers of German conventional and jet-powered fighters and bombers from reaching units in the field, as well as holding up the development and deployment of more 'terror weapons.' The war with Japan was ended by the bomber, and bombers have been used in most postwar conflicts, from Korea to the Middle East.

It was to reinforce the wartime work of RAF Bomber Command, and to make use of early turbojet engines, that British aircraft manufacturers first decided to attempt jet bomber designs. One such project emerged from the Gloster Aircraft Com-

pany, quite understandably as this organization had previously produced the airframe for Britain's first turbojet-powered aircraft and was then busy developing the world-famous Meteor fighter. This bomber had a superficial likeness to the postwar Ilyushin Il-22, although the four W.2B engines were to be installed in partially-submerged nacelles and the wings and tail unit were clearly scaled-up from the F.9. Considering the high risk of failure surrounding such projects, it is hardly surprising that none progressed.

As mentioned previously, the British government appeared to be in no hurry to deploy a postwar jet bomber, although several interesting early designs came off the drawing boards of manufacturers such as Handley Page, Hawker and Bristol. This is not to say that the government was neglecting the jet bomber as a weapon, or was attempting to smother it at birth. In some respects the opposite was true. Prior to the end of World War II Specification B.3/45 had been issued covering a light twin-jet tactical day bomber to replace the very successful de Havilland Mosquito. Provision was to be made for radar bombing equipment. A specification for a larger four-engined jet bomber to replace the Lincoln was later issued as B.14/46. Subsequently, the consensus was to accept the Rolls-Royce Avon turbojet as most suited to a bomber, this being the first axial-flow engine from Rolls-Royce and then under development as a Nene replacement. An axial-flow engine meant great fuel economy over centrifugal-flow engines.

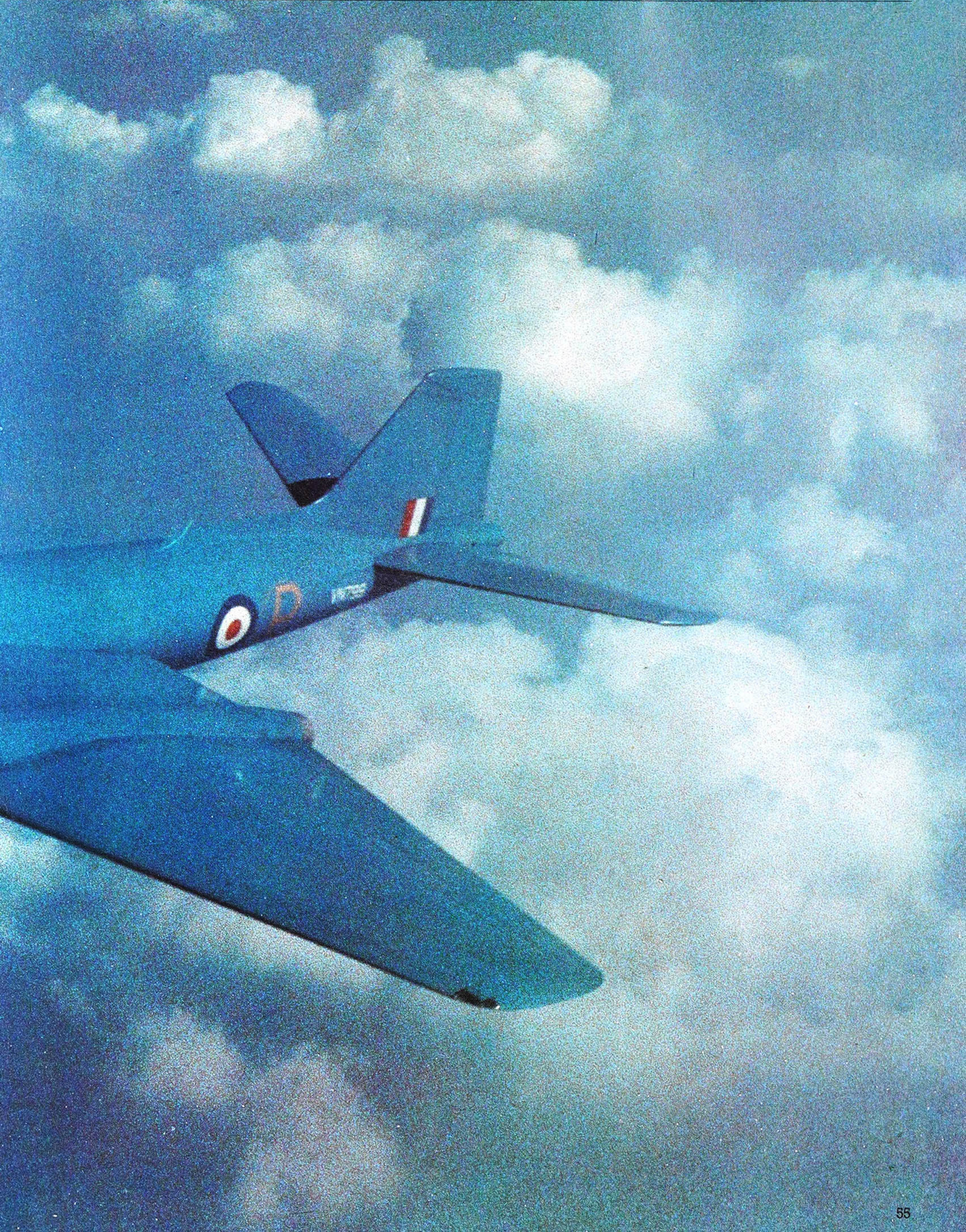
The selection of the Avon to power the first British jet bombers meant a protracted development period, and indeed it was not until mid-1950 that the Avon RA.3 entered production. Both the government and the manufacturers were fully aware of the delays that would be caused by using the Avon, but the possible advantages were too many to be overlooked. Anyway, nobody expected another war in the late 1940s, when disarmament was the watchword in Britain. The result was that the first British jet bombers flew as prototypes well after their American and Soviet equivalents. Had Britain been right to ignore a Nene-powered interim bomber? Equal in importance for a bomber were the twin attributes of high performance to enable it to elude jet fighters and long range. The Nene had a thrust rating of approximately 2268kg (5000lb) and a specific fuel consumption of 1.06lb/hr/lb. The Avon RA.3 gave 2948kg (6500lb) of thrust and had a specific fuel consumption of 0.88lb/hr/lb. With careful design of the airframe, an aircraft using Avons could virtually be guaranteed a winner. Happily the very nature of the turbojet engine allowed designers a field-day, because its relatively small size and lack of a propeller allowed it to be tucked away in parts of the airframe hitherto unavailable. This in itself gave rise to the possibility of achieving outstanding aerodynamic efficiency.

At an early stage in British turbojet development the Avro Lancaster had been used to flight-test the new type of power plant. Eventually the Lancastrian and Lincoln were also adopted for this purpose, testing most British turbojet and turboprop engines. The Lancastrian flight-tested the Avon, two being installed in new nacelles outboard of two piston engines. Each Avon of the development batch was known as RA.1, with either an eight or ten-stage compressor and single-stage turbine. The RA.2 refined engine had a 12-stage compressor of increased diameter and a single-stage turbine, first being flight tested on the Lancastrian on 15 August 1948.

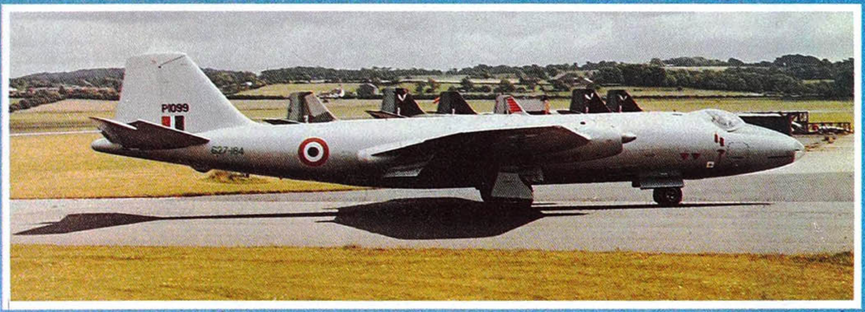
English Electric, a company that had not designed and built an aircraft of original conception since 1926, proposed its A.1 to meet Specification B.3/45. Fortunately English Electric had experience of constructing jet aircraft if not designing them, having been entrusted with the production of the de Havilland Vampire fighter at its Preston works. Production of the Vampire had started in April 1944 and the first aircraft from Preston flew a year later.

The A.1 itself was a remarkable aircraft, flying in the face of the latest trend towards sweptback wings. Of course the company

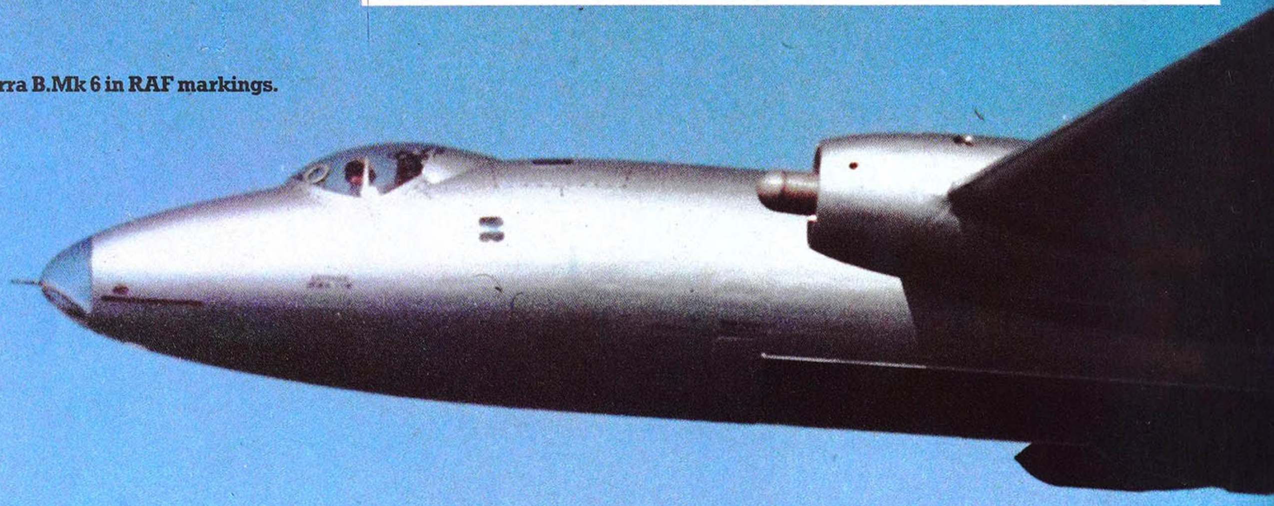
English Electric A.1 *VN799*, first prototype of the Canberra.



One of eight Canberra PR.Mk 57 photographic reconnaissance aircraft in service with the Indian Air Force.



Canberra B.Mk 6 in RAF markings.



RAF Canberra T.Mk 17 electronic countermeasures trainer with a highly-modified nose.

Venezuelan-operated Canberra fitted with auxiliary tip-tanks.

was not adverse to swept wings and indeed incorporated them into its P.1 of 1954, the first British aircraft designed to fly faster than the speed of sound in level flight and progenitor of the Lightning interceptor. The A.1 was the brainchild of the company's chief designer and Engineer, W E W Petter, who had joined the company toward the end of World War II and now headed the newly-established technical and design branch. It was a mid-wing bomber with a symmetrical high-speed aerofoil section. The inner sections of the wings between the fuselage and the engine nacelles were rectangular with a dihedral angle of 2 degrees. Outboard of the engine nacelles were tapered sections, swept back on the leading-edge by 13 degrees and swept forward on the trailing-edge by 19 degrees. Dihedral on the outer sections was increased to 4 degrees. On the round-section, semi-monocoque fuselage were carried a conventional variable-incidence tailplane and a fin and rudder. Interestingly, the tail unit included some wooden structure, which was plywood covered. A nosewheel undercarriage was used. Accommodation was provided for a crew of two, the pilot under a low-profile double-layer Perspex bubble canopy seated slightly to port, and the navigator to the rear under a small roof transparency. Ejection seats and pressurization were provided.

On 13 May 1949 the first A.1 Canberra prototype took off for its maiden flight. One of four prototypes ordered in January 1946, VN799 was piloted by Wing Commander Roland P. Beamont from the company's Warton Aerodrome. VN799 flew on the power of two RA.2s, the pre-production version of the Avon rated at 2722kg (6000lb)st. By the close of the year VN799 had accumulated nearly a hundred flying hours, a third of which were at the experimental establishment at Boscombe Down, during handling trials.

Meanwhile, the second prototype (VN813) had flown in November on the power of two Nene engines. This retrograde step was considered sensible to give the Canberra a back-up tried-and-tested engine should the newly-developed Avon fail to live up to early expectations. There need not have been any worry on that score. The two remaining prototypes were both Avon powered and flew before the end of 1949.

The four prototype Canberras were given the RAF designation B.Mk 1 and could most easily be identified from the B.Mk 2 initial production version by their lack of transparent noses. The first prototype of the B.Mk 2 flew initially on 23 April 1950 and just over a year later, in May 1951, No 101 Squadron received the RAF's first operational B.Mk 2s at Binbrook, replacing the Lincoln. The B.Mk 2 accommodated a crew of three, comprising the pilot, the navigator/plotter to his rear and starboard, and the observer aft of the pilot. Because the B.Mk 2 relied on visual bombing the observer also acted as bomb-aimer using the sighting panels in the nose of the fuselage.

For the period preceding deployment of the V-bomber force, the Canberra was the RAF's most important bomber, gradually taking over from piston-engined bombers and forming new squadrons. Avro, Handley Page and Short Brothers joined in production to speed its entry into service. Four hundred and thirty B.Mk 2s were completed. The Canberra was also selected for service with the USAF and other air forces. For US service a modified night intruder version was developed and produced by the Glenn L Martin Company of Baltimore. To help license production, two B.Mk 2s were flown to America for study. The first of these became the first turbojet-powered aircraft to fly the Atlantic without refueling, on 21 February 1951, the flight from Aldergrove, Northern Ireland, to Gander, Newfoundland, taking just 4 hours 40 minutes. The second followed in August. Another two B.Mk 2s were delivered to Australia to help speed-up crew training in preparation

for the delivery of Canberra B.Mk 20s from the Government Aircraft Factories. The first B.Mk 20 actually flew on 29 May 1953, as the follow-on locally-produced production bomber to the Avro Lincoln. Power for the Australian-built Canberras was provided by locally-built Avons. It is of interest to note that the first of the two British Canberras destined for Australia flew from Lyneham to Darwin in approximately 21 hours, averaging 866km/h (538mph).

Thenceforth one version of the Canberra after another came off the production lines for the RAF and overseas customers. The PR.Mk 3 was a slightly lengthened high-altitude photographic reconnaissance version of the B.Mk 2, first flown as a prototype in early 1950. Quick to follow was the PR.Mk 7 with 3400kg (7500lb)st 109 (RA.7) engines. The T.Mk 4 was a crew trainer accommodating the pupil and instructor forward and a navigator to their rear, which entered service in 1954 and was exported. Two of the first eight Canberras built were configured at one time or another as B.Mk 5 target marker prototypes, but this version was not put into production. However, the

Martin B-57Bs in USAF service, configured as a tandem two-seat night intruders and tactical bombers.

Mk 5 was the first version to incorporate integral wing fuel tanks.

The first updated combat version was the important B.Mk 6, which used Avon 109 engines and carried more fuel. Although far fewer of these were built than of the original Mk 2, it had higher performance and is remembered as the first RAF jet bomber to be used in action, striking at anti-government forces in Malaya. Canberras also took part in the Suez campaign. The B.Mk 6 had a maximum take-off weight of 24,948kg (55,000lb), a maximum level speed of 955km/h (580mph) and a range of 6100km (3790 miles). Up to 2722kg (6000lb) of bombs could be carried in the bomb bay, this weapon load subsequently increased to include a further 2000lb of bombs, rockets or missiles under the wings. The Mk 6 also formed the basis for the B.Mk 15 and B.Mk 16 interim intruder Canberras, their armament extending to AS.30 tactical air-to-surface missiles (with 230kg high-explosive warheads) and tactical nuclear weapons.

While the last of the Canberra B.Mk 2s and Mk 6s were withdrawn from front-line duty with Bomber Command in the fall of 1961, B.Mk 15s and Mk 16s saw out the decade. B.Mk 2s and Mk 6s were thereafter converted for special duties, including radar and radio calibration and for training.

Meanwhile, in 1956 the RAF had received the first of its B(I).Mk 8 long-range night intruders. Armament eventually included four 20mm cannon in an underfuselage pack, two AS.30s or 1000lb bombs carried under the wings, and three similar bombs or tactical nuclear weapons in the bomb bay.

The PR.Mk 9 high-altitude photographic reconnaissance aircraft incorporated more changes than any previous version of the Canberra. Its wings were increased both in span and chord, power was provided by 5100kg (11,250lb)st Avon 206 engines with 15-stage compressors, and a nose station was provided for the navigator. The B(I).Mk 8's offset canopy was retained. The first flight by the prototype was achieved successfully in July 1958 and the Mk 9 entered RAF service two years later.

The PR.Mk 9 is the most important variant of the Canberra in RAF use today, although serving in small numbers. Other versions of the Canberra were produced for the RAF through production or modification but these were not combat types. Of these, the T.Mk 17 electronic countermeasures trainer, T.Mk 19 and Royal Navy T.Mk 22 target aircraft and the TT.Mk 18 target tugs were the last.

This is not the complete story of Britain's first jet bomber. Of the 1300 or so Canberras built many were produced for other air forces, which received newly-built aircraft or refurbished ex-service examples. Users included over the years Argentina, Australia, Ecuador, Ethiopia, France, India, New Zealand, Peru, South Africa, the United States, Venezuela and Zimbabwe (Rhodesia). Ironically, it was an Argentine Canberra that was one of three aircraft lost in the first air engagements of the conflict in the South Atlantic, on 1 May 1982.

Forty-eight of the Canberras built in total were the product of the Australian Government Aircraft Factories and 403 others were built in the United States under B-57 designations. Indeed, the Canberra has been the only jet-powered combat aircraft of non-US origin to have been accepted for USAF service. The distinction USAF has to be made as the US Navy/Marine Corps has accepted both the Harrier and Hawk trainer.

Reference has already been made to the two British-built Canberra B.Mk 2s that were flown to Martin in 1951. Two years later, on 20 July 1954, the first Martin license-built aircraft flew for the first time as a B-57A for the USAF. Powered by two 3266kg (7200lb st) Wright J65-W-1 13-stage axial-flow turbojet engines and incorporating some internal modifications, it had the general configuration of its British counterpart but was a two-seater. This was one of a pilot production batch of eight B-57As. Greater importance, however, was given at this stage to the similar RB-57A photographic reconnaissance version of which 67 were produced.

The first RB-57A was delivered to the USAF in March 1954. Nine months later the service received its first B-57B. This was an extensively modified derivative of the Canberra and the most important US variant. Equipped as a night intruder and tactical bomber, it introduced the tandem seating arrangement under a new long jettisonable blister canopy and with a bullet-proof windscreen forward that typified the Martin Canberra variants. Air brakes were fitted to the wings and rear fuselage. Armament comprised eight 0.50in machine-guns or four 20mm cannon, bombs in the bay attached to a revolving door (developed so that attack speed would not be lowered as with normal drag-inducing doors), and underwing pylons for 5in HVAR rockets, four bombs or napalm. The first B-57B had flown in mid-1954 and 202 were completed.

The B-57C was no more than a B-57B with dual controls, allowing the extra role of pilot training, and the B-57E was the final newly-built combat version. However, while the 'E' had provision to be used as a tactical bomber, it was also a high-speed target tug. For

A USAF Martin B-57 drops eight 750 lb bombs on a target in South Vietnam in late 1967.

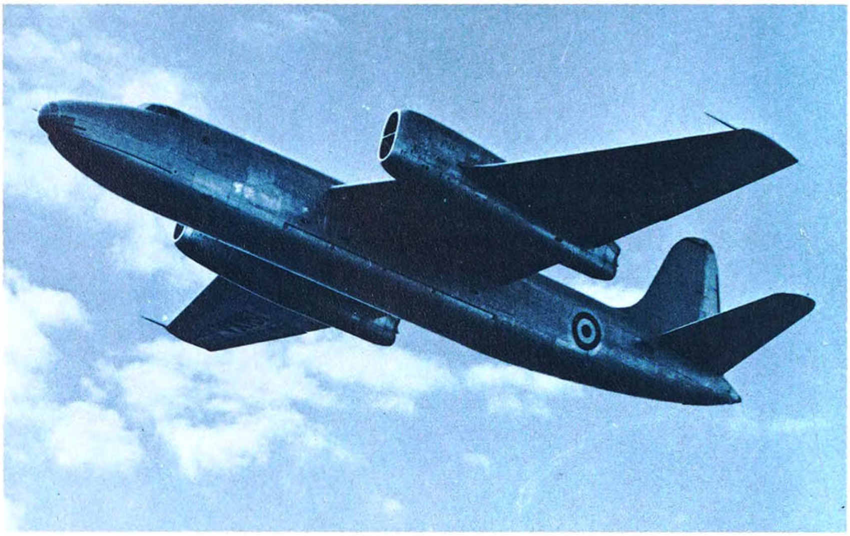
One of 22 Martin EB-57B electronic warfare training and defense evaluation aircraft.

this role four containers housing targets could be carried externally, controls for which were in the cockpit with the cable reels and fittings being carried in the bay. These provided the opportunity for air-to-air and surface-to-air gunnery practice. All this equipment was removable for the more belligerent role.

By far the smallest number of a single version built was the 20 RB-57Ds. Developed for secret high-altitude reconnaissance duties, the RB-57D had 4990kg (11,000lb)st Pratt & Whitney J57-P-37A turbojet engines, a wing span of 32.31m (106ft) instead of the usual 19.51m (64ft), and changes in equipment.

All other versions of the B-57 were modifications and included reconnaissance and electronic warfare training and defense evaluation models (the latter first appearing as the EB-57B). The RB-57F was a high-altitude reconnaissance and radioactive particle sampling conversion by General Dynamics, with Pratt & Whitney TF33-P-11 turbofan engines (8165kg/18,000lb st) and two optional auxiliary J60-P-9 turbojets from the same manufacturer carried on two of the four wing pylons. It also had a 37.32m (122ft 5in) wing span, a new fin and rudder of increased area, new wing tanks instead of the fuselage tank, radar in a lengthened fuselage nose and electronics in the plastic wingtips. These aircraft were later redesignated WB-57F to be compatible with their use by the 58th Weather Reconnaissance Squadron at Kirtland AFB, New Mexico. The B-57G was the last conversion and comprised just 16 of the B-57Bs previously taken back into the USAF service from the Air National Guard to fight in Vietnam, and used during the final period of the conflict as night intruders. These had been modified by Westinghouse under the USAF's Tropic Moon 3 program and featured multifunction radar and other electronic equipment in the nose and chin fairings, and windows to starboard and port for infrared equipment and low light level television camera/laser rangefinder respectively. Today Pakistan still deploys B-57Bs in their original bomber role.

Britain's post-war specification for a four-engined Lincoln replacement resulted in Short Brothers' S.A.4, subsequently to be known as the Sperrin. In many aviation histories the S.A.4 is credited as having been Britain's first four-jet bomber. While it is true that the S.A.4 was built to the first such specification and construction preceded any other type, it was not the first British four-jet bomber to fly as a prototype, as this honor went to the Vickers Valiant.



Second Short S.A.4 Sperrin.

The S.A.4 was conceived to a much more challenging specification than faced English Electric with B.3/45. B.14/46 required a bombload of up to 9070kg (20,000lb), a range of 2780km (1725 miles) while carrying half the maximum bombload, a maximum range of more than twice this with a nuclear stand-off missile in the bomb-bay, a service ceiling of 13,720m (45,000ft) and a cruising speed of 805km/h (500mph). And yet this specification was soon considered to represent a 'stop gap' bomber only.

As with the Canberra, the S.A.4 was designed to use Avon turbojets as the powerplant, these being carried in pairs, one above the other, on the unswept shoulder-mounted wings. The fuselage and tail unit were no more radical in design than the wings. Two prototypes were ordered, the first to be powered by preproduction Avon RA.2 engines and the second with initial-production RA.3s. There is no doubt that Short Brothers expected the S.A.4 to enter production for the RAF, and indeed prepared for this at prototype construction stage. This was not to be. While the two S.A.4 prototypes were being built, a proposal had been received from Vickers for a far more advanced bomber to meet Specification B.45/46. The later specification had been drawn up on 1 January 1947 to cover the development of a follow-on long-range bomber incorporating advanced design features such as swept back wings, data on which was being gleaned from captured German material and original research.

Construction of the S.A.4 prototypes had begun in 1948, but the first with RA.2 engines did not fly for the first time until 10 August 1951. The second made its maiden flight one year and two days later. However, by then Vickers had not only completed design and construction of its bomber, but had managed a first flight, on 18 May 1951, some months prior to the Sperrin. The speed at which Vickers managed to get its bomber into the air made an interim four-jet bomber unnecessary and may be seen as the final death-blow to the Sperrin. Actually,

it is thought likely a decision not to proceed with the Sperrin had been made before either bomber flew. Nevertheless, once airborne the Sperrin proved itself an outstanding aircraft, demonstrating a maximum speed of 908km/h (564mph) and with excellent handling characteristics. In the event the two prototypes were used for nothing more belligerent than testing new engines and equipment. As for the company's activities with jet bombers, it eventually produced a total of 138 Canberras in various versions under sub-contract and as late as the 1960s was still engaged in modification programs to produce the Canberra U.Mk 10 target drones for use at Woomera, Australia, and in Malta.

Although the Vickers bomber, later to be known as the Valiant, was far more advanced than the Sperrin, it was in turn eclipsed by the two other bombers proposed to Specification B.35/46, subsequently named the Vulcan and Victor. Indeed, the Valiant was the first of Britain's V-bombers to enter RAF service and the first to be retired and examples of the other two still fly today. The Vickers proposal for a bomber had not been an instant success, as prototypes were ordered under the new specification B.9/48 only after continued work on the project suggested that it could fulfill most Air Ministry requirements. There is little doubt that the Air Ministry favored the Avro and Handley Page designs. Perhaps the Valiant's greatest asset was its fairly conventional configuration, which would allow early production and so provide the RAF with a modern strategic bomber should the bomber prototypes ordered from Avro and Handley Page fail.

The Vickers Type 660 Valiant was designed as a shoulder-wing bomber with compound sweepback. Chord at the wing-root was an impressive 10.82m (35ft 6in). The circular-section semi-monocoque fuselage on production examples carried a large dielectric panel under the nose and spoilers were fitted forward of the huge bomb bay to combine with a hinged section of the lower fuselage aft to deflect the airflow when the bomb-bay doors were open. The tail unit was conventional, with the variable-incidence tailplane mounted midway up the slightly swept fin. Each main unit of the tricycle undercarriage comprised two wheels in tandem, retracting into the wings. Power was provided by four Rolls-Royce Avon engines installed in the trailing-edges of the inner portion of the wings, fed with air from leading-edge intakes. The crew of five was accommodated in pressurized compartments and a prone position was provided under the cabin in a teardrop fairing for the bomb-aimer. No defensive armament was considered necessary because of the aircraft's high cruising speed and altitude, but the bomb bay carried 21 1000lb bombs or a single large conventional or nuclear bomb.

Total production of the Valiant was 107 aircraft, which included the original prototypes and a single Mk 2, the final Valiant off the production line being delivered on 24 September 1957. The prototypes had been powered initially by Avon RA.3 and RA.7 engines, but the ultimate engine fitted to the Valiant was the RA.28 of 4536kg

Vickers Valiant V-bombers in RAF service. The center aircraft is a B.Mk 1 and on the left a B(PR)K.Mk 1.

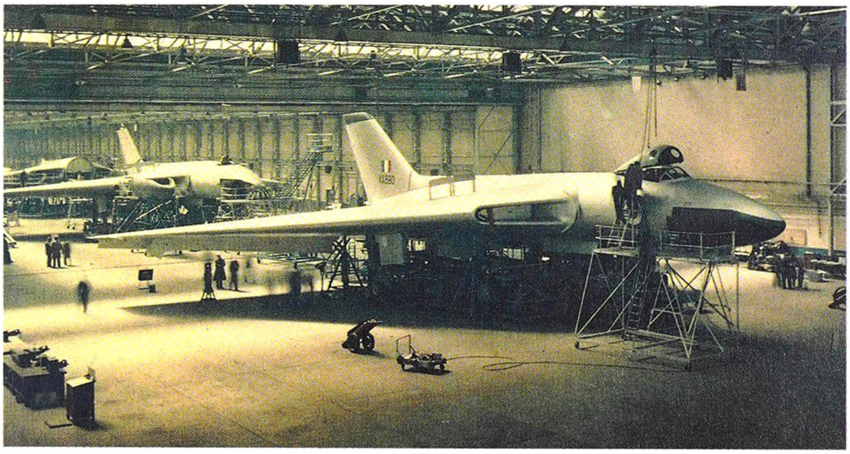
(10,000lb) st. Production versions comprised the B.Mk 1 bomber, B(PR).Mk 1 bomber and photographic reconnaissance aircraft, B(PR)K.Mk 1 bomber/photographic reconnaissance aircraft/flight refueling tanker and receiver with a probe on the nose, and the B(K).Mk 1 bomber and refueling tanker able to carry 45,330 litres (9,972 Imperial gallons) of fuel, of which nearly half was transferable.

The B.Mk 1 first went into service with No 138 Squadron RAF, in early 1955. Several Valiant squadrons were operational by the time of the Suez crisis and took part in the fighting that followed. In March 1958 No 214 Squadron, one of those involved in the Suez campaign while operating from Malta, started development of flight refueling. It subsequently became the first squadron to be operational in the tanker role with the RAF's first purpose-built Victor tanker. Many very long-distance flights were carried out by No 214 Squadron using flight refueling. These included one on 2-3 March 1960 when a Valiant flew 13,679km (8500 miles) around the UK, remaining airborne for 18 hours and 5 minutes and carrying out two refuelings. Another in May of the same year covered 13,052km (8110 miles) in 15 hours 35 minutes, the Valiant involved flying non-stop from Marham, England, to Singapore. This aircraft was refueled over Cyprus and Karachi, Pakistan, by tankers from the same squadron.

The Valiant also dropped the first British atomic bomb and the first British hydrogen bomb. A Valiant of No 49 Squadron dropped the A-bomb on 11 October 1956 over Maralinga, Australia, and an aircraft of the same squadron released the first H-bomb on 15 May 1957 over the Christmas Island area in the Pacific. It should be noted here that this was only one year since the world's first air-transportable hydrogen bomb was dropped from a USAF bomber over Bikini Atoll on 21 May 1956.

In 1964 Valiants were ordered to change role from high-altitude to low-level bombers. This was caused by realization that the new and effective surface-to-air missiles and interceptors in Soviet service rendered high-altitude missions extremely risky. Typical of the missiles that brought about this change was the V750VK, known to NATO as *Guideline*, which had an effective ceiling of more than 18km (11.25 miles). Part of the evidence for such a decision had come as early as 1960, when a USAF U-2 reconnaissance aircraft flying at extreme altitude was brought down by a Soviet missile. Within a year the Valiant had been retired because of metal fatigue. Maximum take-off weight with one 10,000lb bomb, but without underwing auxiliary fuel tanks, was 62,595kg (138,000lb), with an overload weight of 79,379kg (175,000lb). Maximum speed at 9145m (30,000ft) was Mach 0.84, service ceiling was 16,460m (54,000ft), and maximum range with auxiliary tanks was 7240km (4500 miles).

Britain's second V-bomber and the first jet bomber in the world to employ delta-wings, was the Avro Type 698 Vulcan. One of the three bombers proposed to Spe-



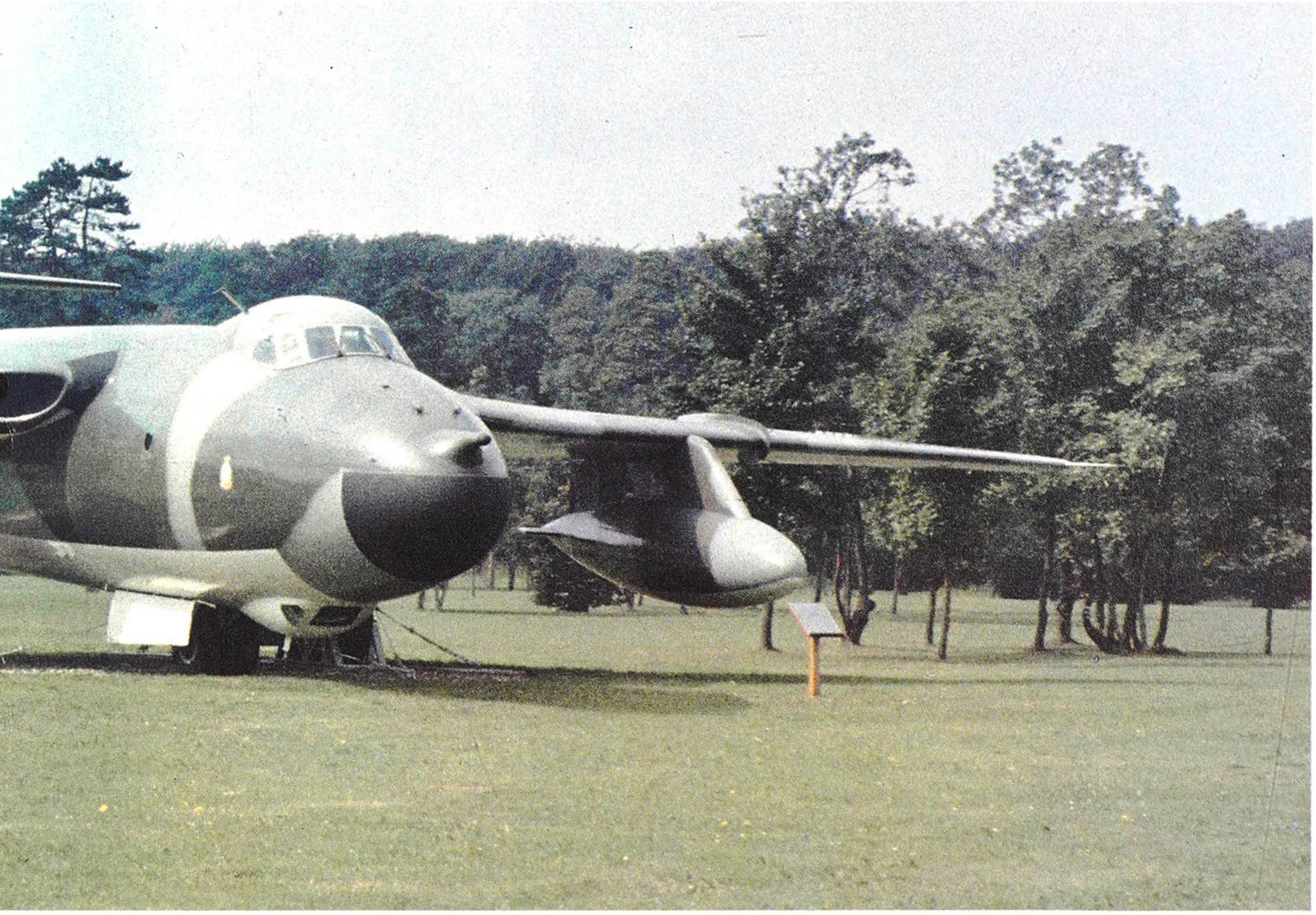
First production Vulcans under construction.

cification B.35/46, it was by far the most daring. In theory the delta wing configuration offered good handling characteristics at low and high speeds, something that the swept back wing lacked. Furthermore, a great deal of fuel could be carried in the large-area wings, leaving the fuselage clear for the bombload and equipment.

Of course, the choice of delta wings by Avro meant charting new waters and so it was decided at an early stage to flight-test one-third scale deltas on a small number of single-engined research aircraft. These were known as Avro Type 707s, the first (for low-speed handling trials) flying on 4 Septemper 1949. Others followed for low and high-speed research, and also in two-seat configuration for pilot training. By the time of the initial Type 707's first flight the best part of two years had passed since the original proposal had been accepted by the Air Ministry.

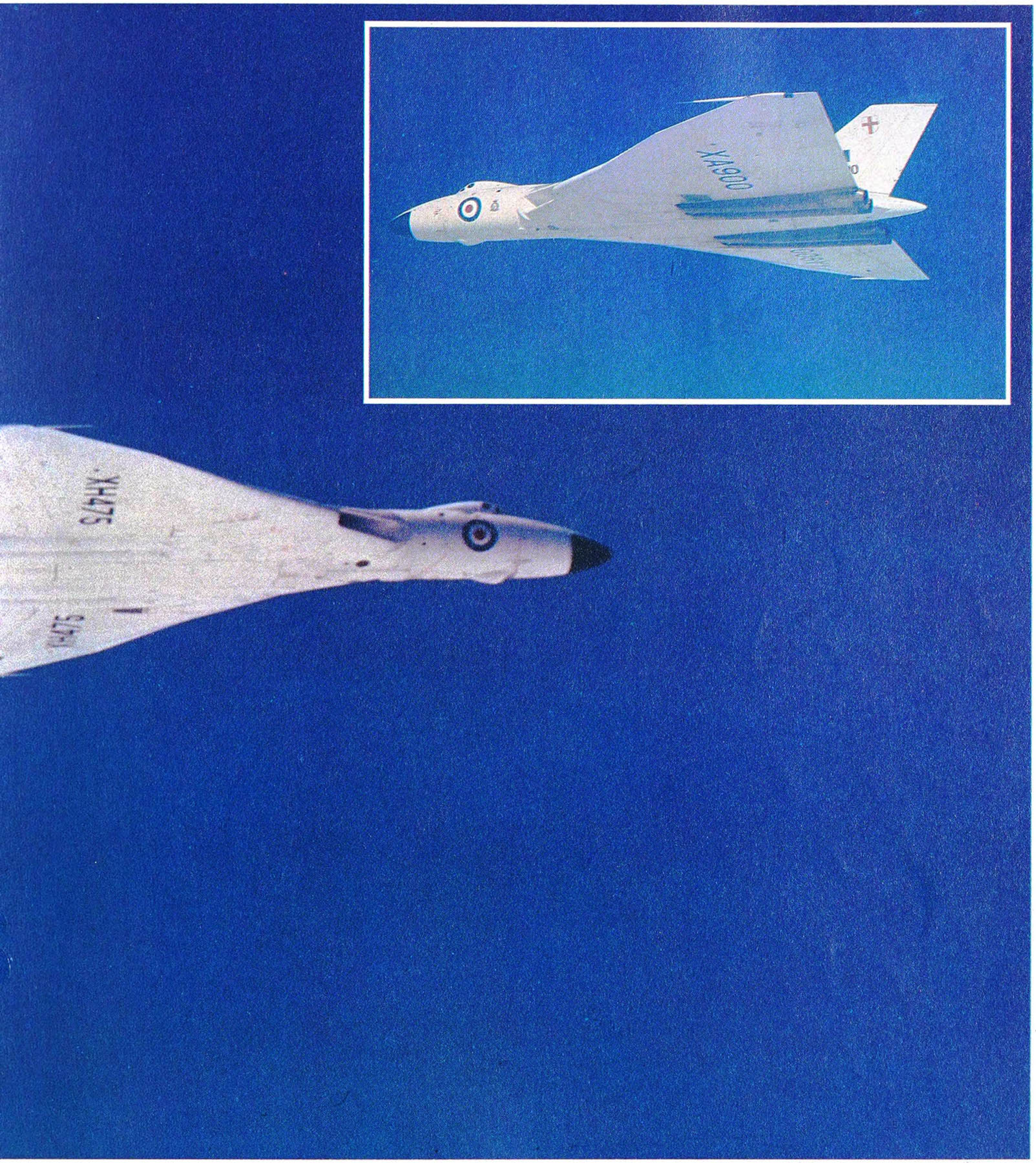
With the information gleaned from the Type 707 research program, the final design work for the Avro Type 698 was completed. The first prototype Vulcan, fitted with four Avon RA.3 engines, flew for the first time on 30 August 1952. It was subsequently re-engined in turn with Bristol Siddeley Sapphires and in the later 1950s with Rolls-Royce Conways. The second prototype first flew on 3 September 1953, power being provided by four of the Bristol Sideley Olympus 100 turbojets specified for production Vulcans. The fuselage was lengthened slightly to eliminate the need for shortening the nosewheel during undercarriage retraction. Like the Type 707s, both

Camouflaged Valiant B(PR)K.Mk 1 at Marham, earmarked for display at the RAF Museum, Hendon.



prototypes featured delta wings with straight leading-edges. This planform was also used on the first few production Vulcan B.Mk 1s, the first of which took to the air on 4 February 1955. High priority was given to Vulcan production. On 5 October 1955 the second prototype had flown with modified wings and this modification became standard on all production aircraft thereafter. The new wing planform allowed for a reduced leading-edge sweep, but with compound sweep on the outer half of each wing, thereby reducing previously-encountered buffeting during high-altitude maneuvers.

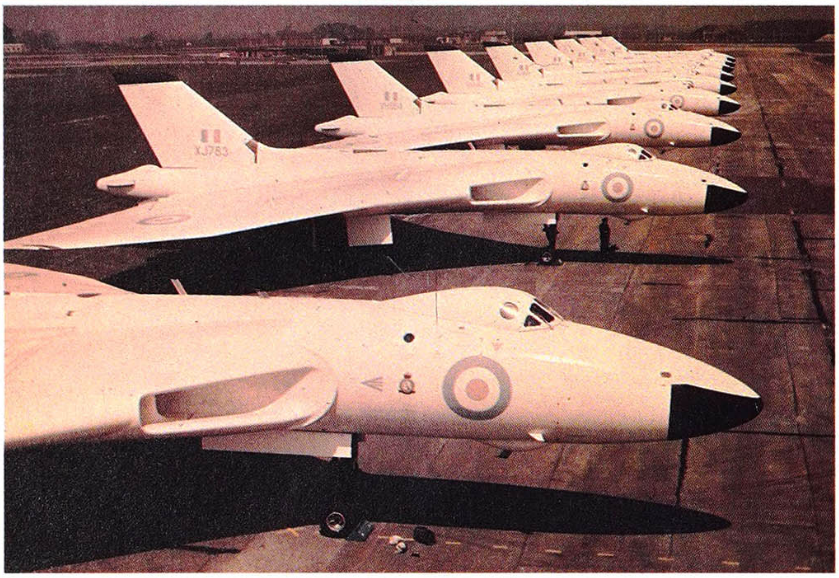
The first production Vulcan B.Mk 1s had 4536kg (10,000lb)st Olympus 101 turbojets fitted in the wing trailing-edges, subsequently rerated at 4990kg (11,000lb)st. Starting with the fourteenth set of engines, Olympus 102 were substituted, rated at 5443kg (12,000lb)st, all of which were later modified



to Olympus 104 Standard, rated at 6123kg (13,500lb)st. The B.Mk 1 first became operational with No 83 Squadron in 1957 and a total of 45 aircraft was built. By 1960 the planned three squadron deployment of the Vulcan was completed. In the following year a number of B.Mk 1s were modified and redesignated B.Mk 1As, each carrying B.Mk 2-type ECM and other electronics in a bulged tail-cone. Interestingly, the second production B.Mk 1 was used for some years by the Blind Landing Experimental Unit at the Royal Aircraft Establishment, Farnborough, where development of auto-

Vulcan B.Mk 1s with the new wing shape.

Inset: Vulcan B.Mk 1 used by No 230 Operational Conversion Unit, which received Vulcans before the first operational squadron.



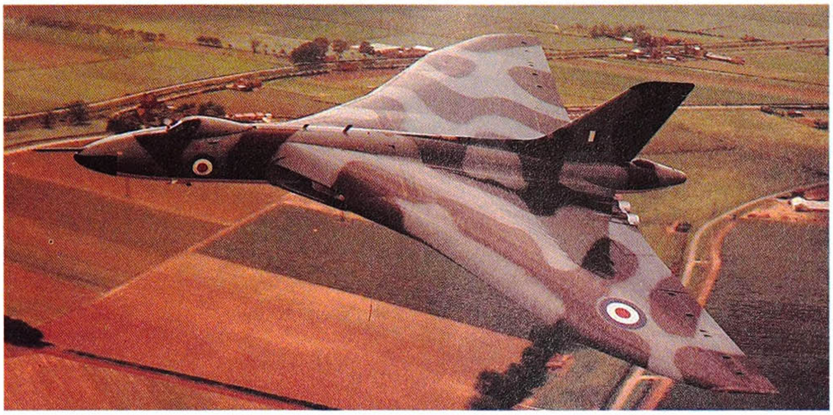
Above: Line-up of Vulcan B.Mk 2s in original anti-flash finish.

landing systems and other systems was conducted.

On 31 August 1957 the second prototype Vulcan took off for the first time with a larger wing as designed for the follow-on and more powerful B.Mk 2 production variant. Span was increased from 30.18m (99ft) to 33.83m (111ft), and wing area from 330.2sq m (3,554sq ft) to 368.3sq m (3964sq ft). Instead of the Mk 1's two ailerons and two elevators, each wing of the Mk 2 was given elevons. Wing aspect ratio of the Mk 1 was 2.78, that of the Mk 2 was 3.1.

The first of the production B.Mk 2s made its maiden flight on 30 August 1958 and ini-

Below: Vulcan B.Mk 2 *XH537* during Skybolt trials.



tial deliveries to No 83 Squadron began in July 1960. Production was completed at the end of 1964. The initial 7711kg (17,000lb)st Olympus 201 engines gave way during the production run to 9072kg (20,000lb)st Olympus 301s, which bestowed a maximum take-off weight of more than 81,645kg (180,000lb), a maximum cruising speed of more than 1005km/h (625mph) at 15,240m (50,000ft), a maximum cruising altitude of 16,750m (55,000ft) and an unrefueled combat radius at high altitude of 3701km (2300 miles).

Right: One of the last Vulcans built, camouflaged for low-level operations.

Blue Steel carried under a Vulcan B.Mk 2.


XL446

Victor B.Mk 1s at a Fanborough air show.

Armament for the Mk 2 was as for the Mk 1/1A, comprising 21 1000lb bombs or free-fall nuclear weapons, but with the added provision of the Blue Steel nuclear stand-off missile, one carried semi-recessed below the fuselage of each aircraft. Blue Steel became the strategic nuclear weapon of the Vulcan from February 1963, first with No 617 Squadron. It was selected for use after extensive trials at Aberporth in Wales and the Woomera range in Australia using Valiant and Vulcan B.Mk 1 aircraft as test vehicles. The first launches of production standard missiles took place in mid-1960. For some time the US Skybolt missile had been expected to enter service as the RAF's strategic deterrent, two to be carried under the wings of a Vulcan, but this missile was cancelled in December 1962.

With the deployment of Polaris by the Royal Navy, Blue Steel was dropped and Strike Command Vulcans were given the new role of low-level attack, a task which they performed brilliantly. In 1973 a handful of Vulcans became operational with No 27 Squadron as SR.Mk 2 strategic reconnaissance aircraft, replacing Victors used in this role. The phase-out of the Vulcan B.Mk 2 planned for 1982 and the consequences to this of the Falkland Islands conflict have been mentioned previously, but on 18 June that year the first flight took place of a Vulcan configured for an entirely different role. This ex-B.Mk 2 had been converted in just 50 days into a flight refueling tanker, an example of what can be achieved under pressure with the right industrial backing. Within five days this first Vulcan tanker was at RAF Waddington. The modification of the bomber into a tanker entailed the installation of a redesigned hose drum unit inside the bulged tail-cone and three fuel tanks in the former bomb bay.

The Handley Page Victor was designed and built with a unique crescent wing.

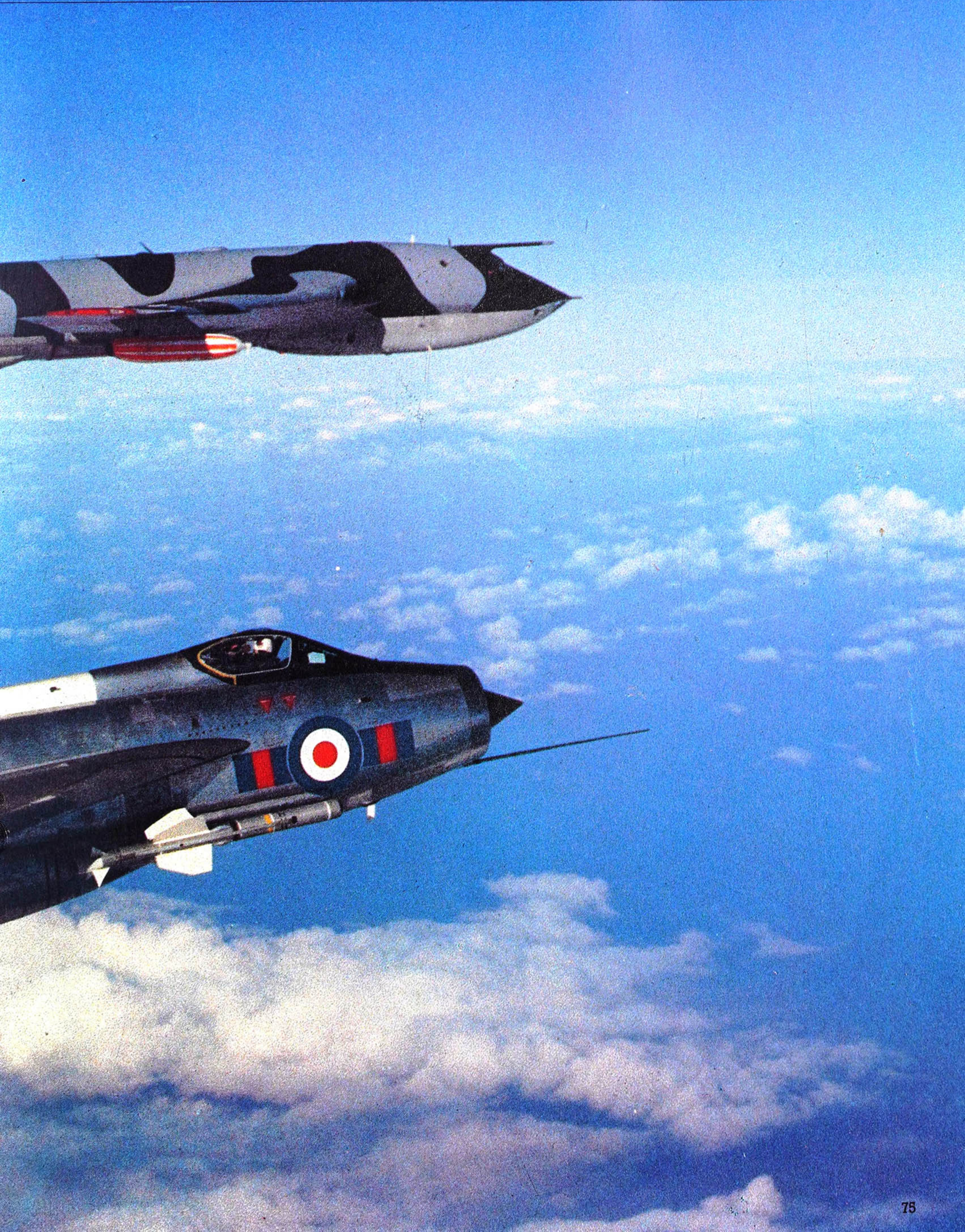
The third and final V-bomber was the Handley Page Victor, an aircraft that featured a unique crescent wing. This was another wing configuration that originated in wartime Germany and was basically a swept wing that became less swept, with a reduced thickness/chord ratio along its outer span. The intention was to allow an unchanging critical Mach number across the span. Initially, Handley Page had to face the problem of a lack of research into this wing configuration, as had Avro with its delta wing. There appeared no alternative but to construct one-quarter scale wings and flight test these on a modified Supermarine Type 521, resulting in a research aircraft known as the HP 88. Powered by a Nene turbojet, the HP 88 first flew on 21 June 1951. Unfortunately the aircraft was destroyed while under test before the potential of the crescent wing had been fully realized. Nevertheless, Handley Page went ahead with its full-size bomber prototype using crescent wings. Happily this turned out to be the correct decision.

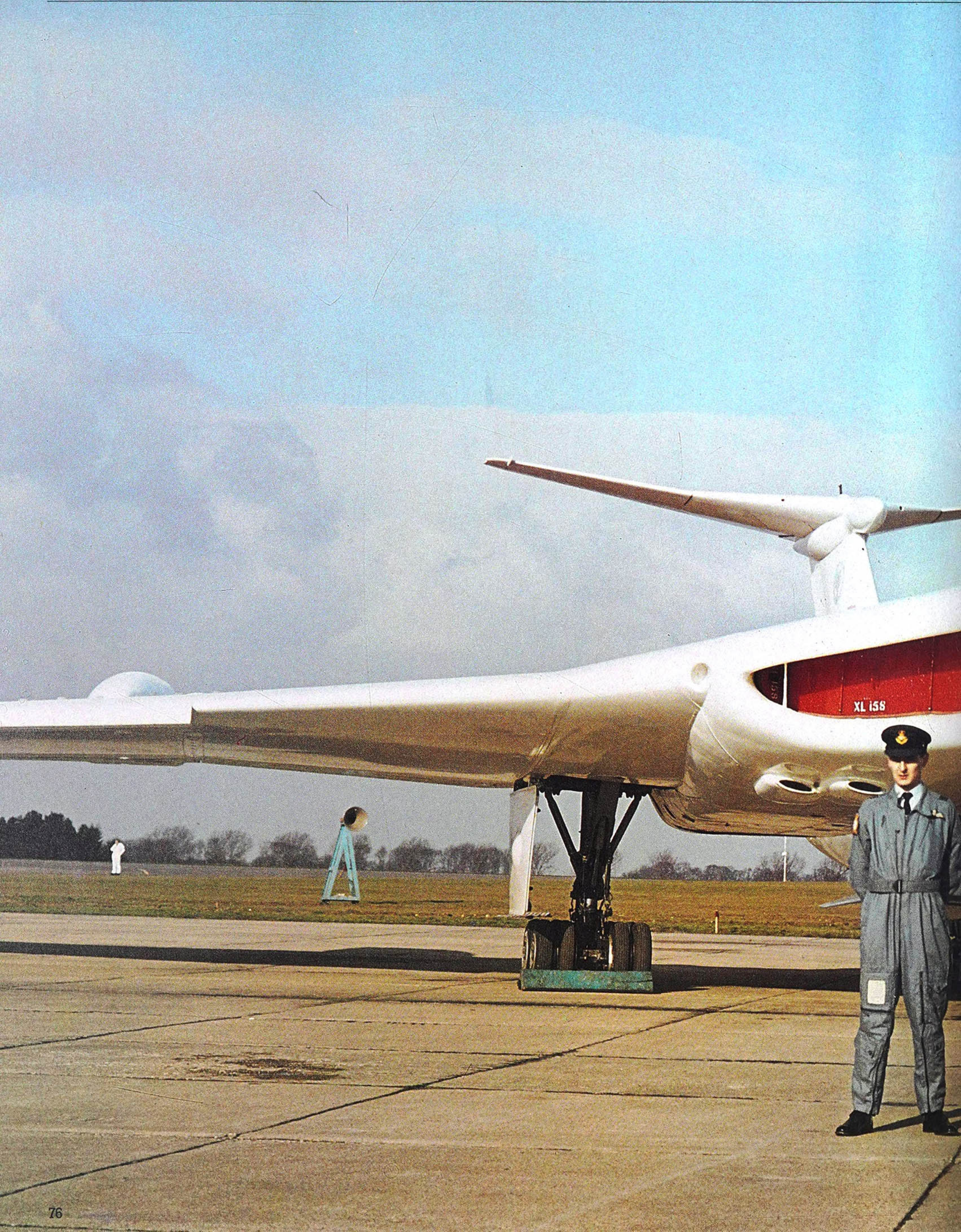
Two prototype HP 80 bombers, later known as Victors, were built, the first taking to the air on 24 December 1952. The second prototype did not fly until September 1954. Initial production Victor B.Mk 1s had been ordered six months before the first prototype flew and the first B.Mk 1 made its maiden flight on 1 February 1956. The first RAF squadron to become operational with the Victor B.Mk 1 was No 10 Squadron in early 1958. By 1960 four squadrons were operational with the 50 production B.Mk 1s. Of these 24 became B.Mk 1As when fitted with ECM in the rear fuselage.

Victor B.Mk 1/1As were powered by four 4990kg (11,000lb)st Bristol Siddeley ASSa7 (or Series 200) engines, mounted within the inboard trailing-edges of the wings. In respect of their position, they were similar to the Valiants and Vulcans. Wing span was 33.53m (110ft) and wing area 223.5sq m (2406sq ft). Maximum speed was approximately Mach 0.92, which backed up the Under Secretary of State for Air's claim in 1955 that the Victor had flown close to the speed of sound at an altitude of more than 15,240m (50,000ft). In 1957 a B.Mk 1 actually exceeded Mach 1 in a shallow dive. No defensive armament was carried but the offensive load comprised 35 1000lb bombs or free-fall nuclear weapons.

In February 1962 No 139 Squadron RAF became the first to be equipped with the improved Victor B.Mk 2, which first flew on 20 February 1959. Changes included the use of four 9344kg (20,600lb)st Rolls-Royce Conway R.Co.17 Mk 201 turbofan engines (then

Ex-Victor B.Mk 1A bomber converted into a flight refuelling tanker and seen here in the company of a Lightning interceptor.

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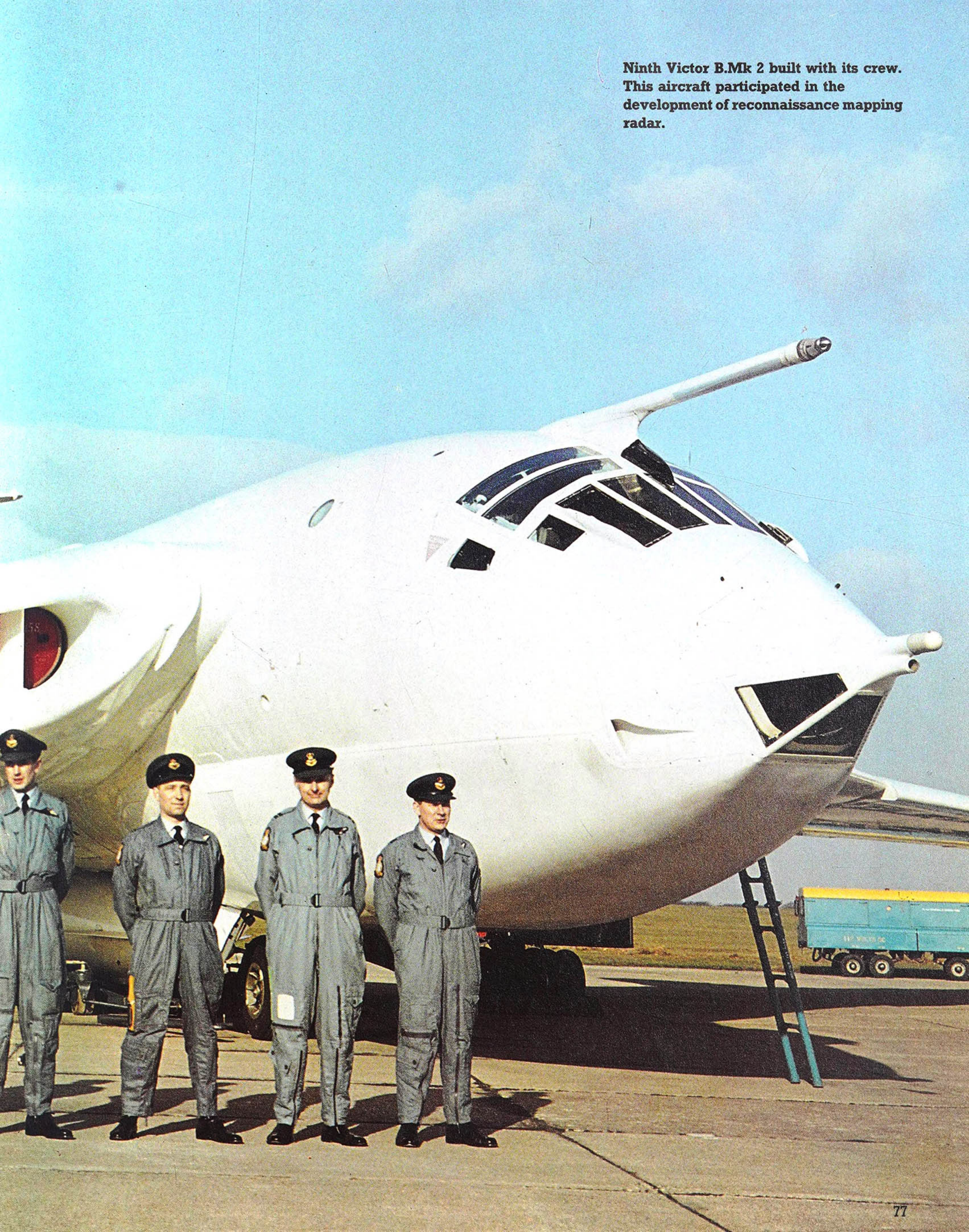


Ninth Victor B.Mk 2 built with its crew. This aircraft participated in the development of reconnaissance mapping radar.

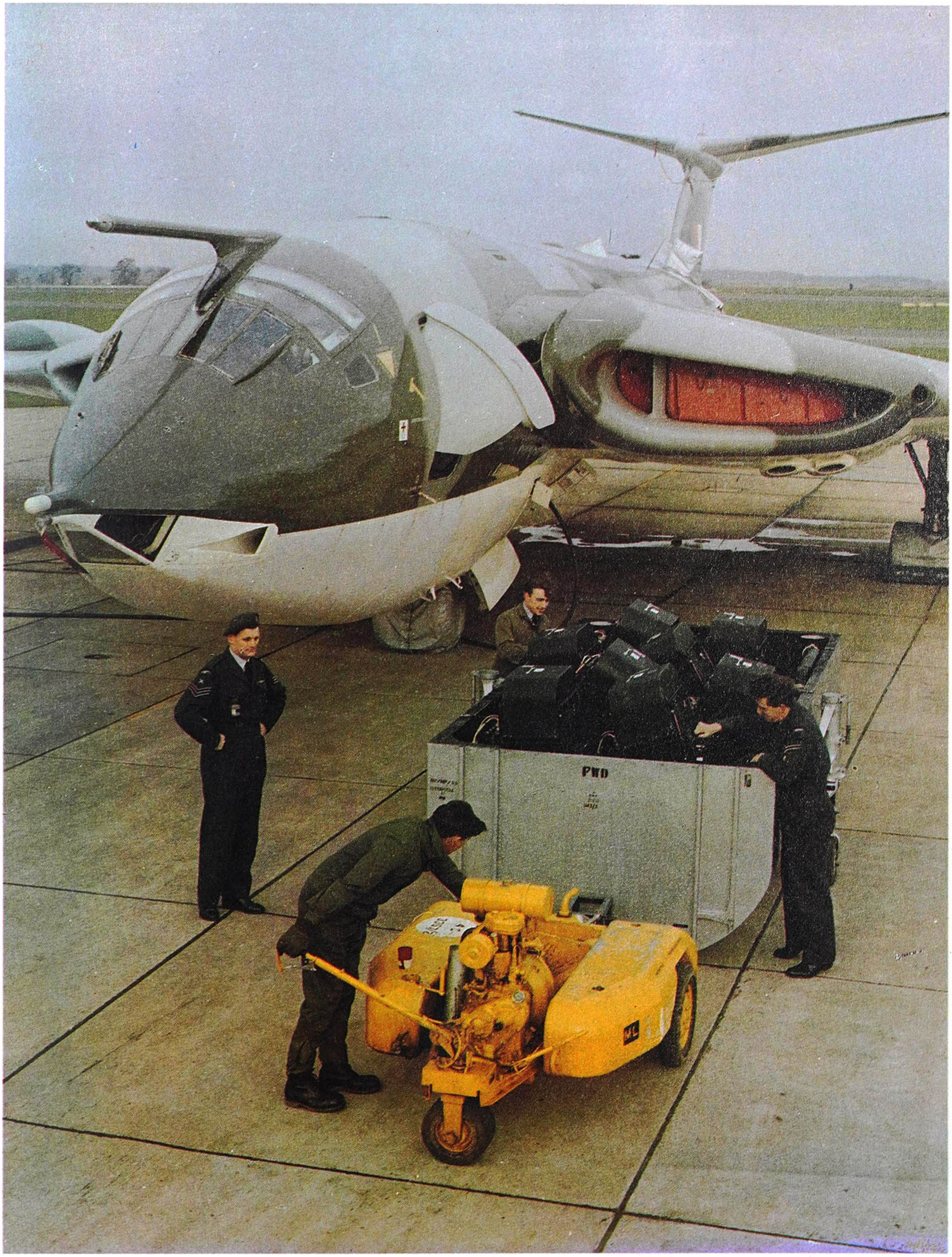
Blue Steel stand-off missiles prepared for Vulcan and Victor bombers.

known as by-pass turbojets), fitted in 36.58m (120ft) span and 241.3sq m (2597sq ft)-area wings. These changes allowed the maximum cruising altitude to be increased from 13,715m (45,000ft) for the B.Mk 1 to 16,765m (55,000ft), and combat radius at high altitude was 3701km (2300 miles). The air intakes for the engines were enlarged, retractable scoops to feed ram-air to the two turbo-alternators for emergency power supplies were fitted either side of the rear fuselage, and a dorsal fillet was added forward of the tailfin (which still carried its distinctive swept back tailplane with marked dihedral). Mk 2 aircraft were subsequently given streamlined fairings above the trailing-edges of the wings. These helped reduce drag at high speed and contained 'window' (chaff) dispensers to confuse radars. Perhaps the most identifiable feature of the Victor in all versions was the design of its nose, with its large dielectric blister under the panel-glazed nose.

Production of the Victor B.Mk 2 totalled 34 aircraft, 21 being subsequently modified to carry the Blue Steel nuclear stand-off missile. The first squadron so equipped was No 139 in early 1964. Four years later the Victor finally passed out of service as a bomber. However, six B.Mk1As had previously become B(K).1A two-point flight refuelling tankers and a further 24 bombers were modified as K.Mk 1/1A three-point tankers. Also, nine B.Mk 2s had been adapted as strategic reconnaissance aircraft under the designation SR.Mk 2, serving with No 543 Squadron until replaced by Vulcans in 1974. On 8 May 1974 the first Victor K.Mk 2 three-point flight refueling tankers (with Mk 20 pods) entered RAF service, 24 being delivered by 1977. These were modified B.Mk 2s and SR.Mk 2s with wing span reduced to 35.66m (117ft) and other changes. A valuable part of today's RAF, K.Mk 2 tankers operating during the Falkland Island campaign performed nearly 600 missions, of which all but one percent were entirely successful.

The earlier phase-out of bomber versions of the Valiant and Victor, and the planned withdrawal of the Vulcan in 1982, were expected to end more than a quarter of a century of V-bomber deployment by the RAF. As for the Canberra, this has no offensive role to play in today's RAF. A supersonic replacement had been designed and built to prototype stage as the TSR 2, but this was cancelled during the 1960s for economic reasons, although it was then by far the most formidable aircraft of its type in the world.

Ground crew prepare to load reconnaissance cameras on to a Victor SR.Mk 2.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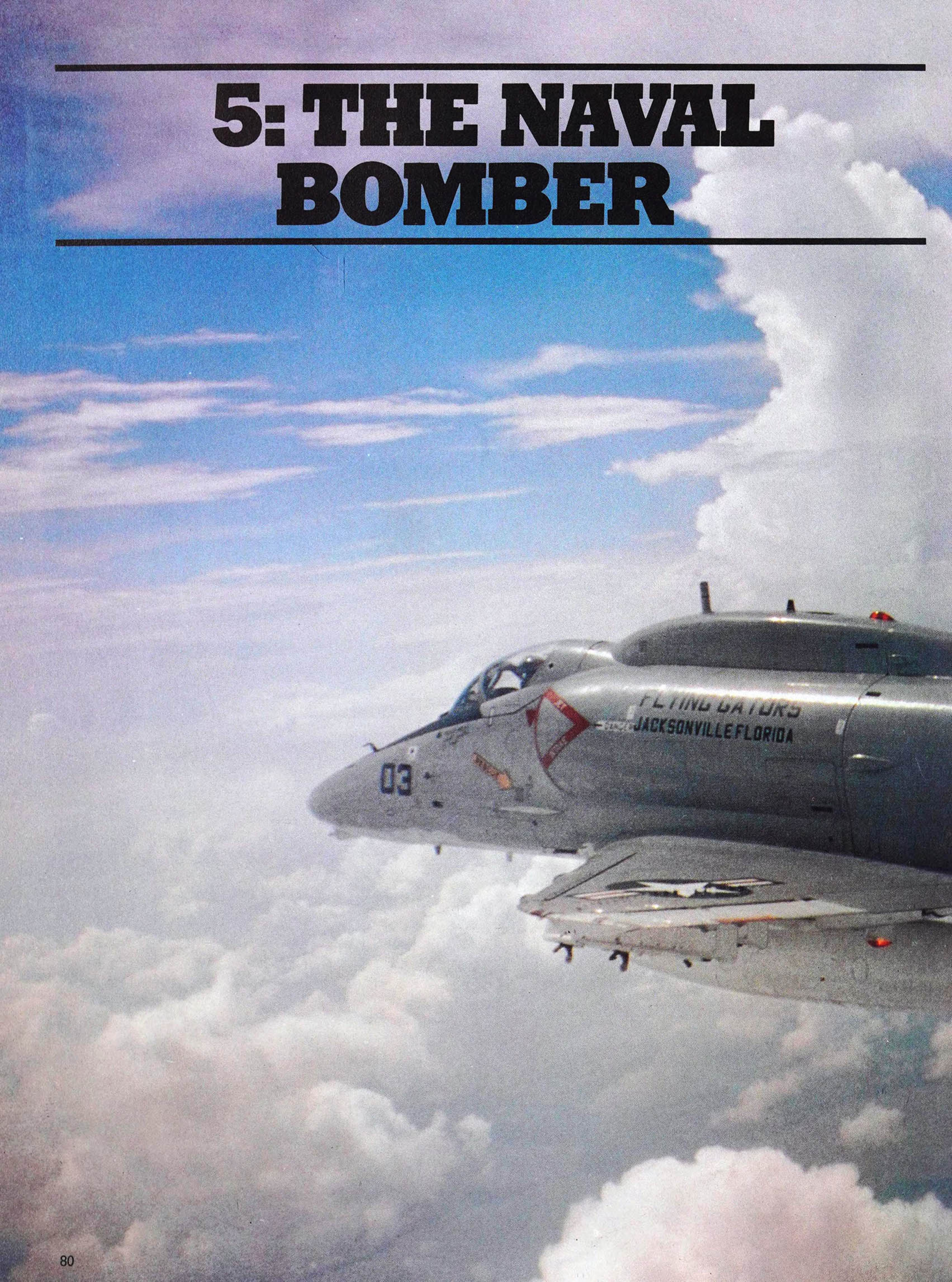
5: THE NAVAL BOMBER

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Because so few nations have deployed aircraft carriers postwar, the number of jet-powered aircraft built for the role of naval attack bomber has been small. Of these, only the United States has produced attack bombers of any size. This was made possible by the deployment by the US Navy of 'super-carriers.' Indeed, most naval bombers originated in the United States and this situation is likely to continue in the future as the US Navy deploys virtually all of the world's carriers suited to non-VTOL aircraft.

Two manufacturers were paramount in supplying early jet bomber/attack aircraft to Navy requirements, namely North American and Douglas. To the former company went the honor of supplying the first postwar carrier-borne attack bomber incorporating turbojet engines, in the shape of the AJ Savage. This aircraft also gave the US Navy its first capability to delivery atomic weapons.

Development of the Savage was initiated in 1946, with the first XAJ-1 prototype flying on 3 July 1948. A three seater with pressurized accommodation, it was powered by two 2400hp Pratt & Whitney R-2800-44W piston engines in nacelles under the shoulder-mounted unswept but tapering wings and a 2086kg (4600lb)st Allison J33 turbojet engine installed in the rear fuselage. For cruise flight only the piston engines were expected to be used, the turbojet providing extra power for take-off and for increasing speed in combat. The prototype demon-

more than 740km/h (460mph).

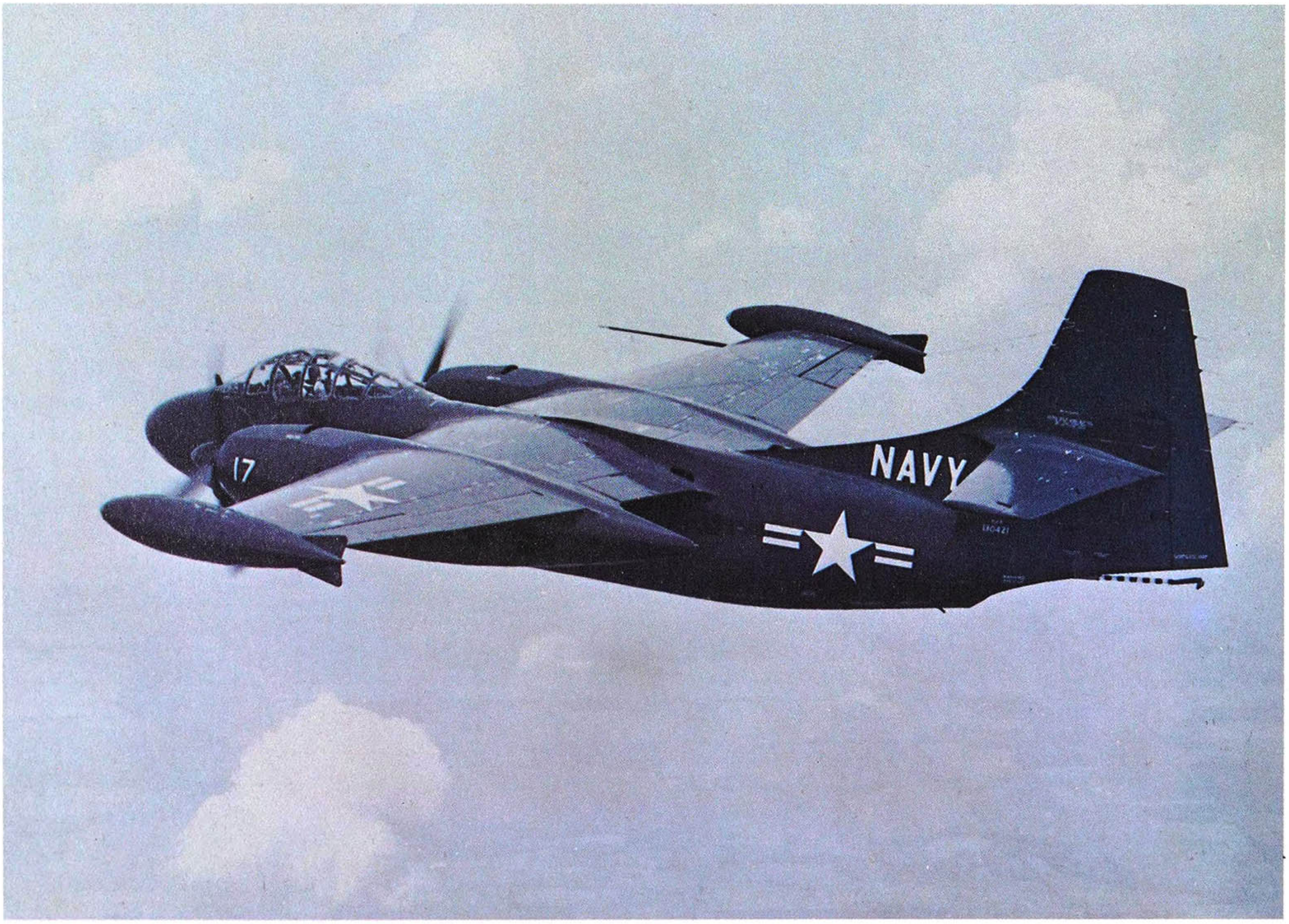
Production of the Savage for the Navy began with 43 AJ-1s, differing mainly in the standard use of wingtip tanks. The first production AJ-1 flew in May 1949 and the type entered service a few months later. Approximately 5440kg (12,000lb) of conventional bombs or a nuclear weapon could be carried in the bomb bay. With the arrival of the improved AJ-2 versions, many AJ-1s were modified into flight refueling tankers, using the probe and drogue system. A pack containing the necessary equipment for this role was installed in the bomb bay.

The AJ-2 and AJ-2P followed the AJ-1 into service, changes including the use of R-2800-48 piston engines and the turbojet, a taller fin and rudder of increased area, a tailplane without the dihedral of the AJ-1 and increased fuel. The first production version was the AJ-2P photographic reconnaissance aircraft, carrying cameras in a redesigned and more bulbous nose for day and night photography at all altitudes. Photo-flash bombs were carried in the bomb bay. The first AJ-2P flew on 6 March 1952 and production was ended in 1954.

The AJ-2 attack bomber followed the AJ-2P, the first aircraft flying on 19 February

Previous page: Douglas A-4F Skyhawk flown by the US Marine Corps, with a J52-P-8A engine and improved avionics carried in a dorsal hump.

North American AJ-2 Savage naval attack bomber.



Douglas A3D-2 Skywarrior converted into an EKA-3B for service in Vietnam with Tactical Electronics Warfare Squadron VAQ-135.

1953. However, this version too was soon being modified for the tanker role. In September 1962, under the new designation system which rationalized US military aircraft designations, surviving Savage aircraft took A-2 designations. An attempt to modernize the design had previously been made with the introduction of a prototype with Allison T40 turboprop engines under the wings in place of the former piston engines. This resulted in the XA2J-1 prototype. In fact this was a completely redesigned aircraft, with a new slimmer fuselage and new cockpit, a more modern tailplane, and with provision for radar-controlled 20mm cannon in the tail. This did not enter production.

1956 was a significant year for the US Navy and its future attack capability. In April of that year the first of its big Skywarrior attack bombers entered service, followed in October by the first of its small Skyhawks. Both were from Douglas and both had a major impact on Navy capabilities.

The Skywarrior was a bold concept, designed to provide the US Navy with an aircraft of tremendous speed and range and large enough to carry the heaviest conventional bombs or deliver nuclear weapons. It proved capable of high or low level attack, and eventually encompassed photographic reconnaissance and mine-laying roles, and yet could be launched from and retrieved by aircraft carriers.

The events that made development of the Skywarrior possible dated from World War II, when the US Navy commissioned the first of its new *Essex* class of 'supercarriers.' *Essex* was followed immediately after the war by the *Midway* class and then by the *Forrestal* class. These huge vesels in service or planned would, it was decided, allow the operation of much heavier aircraft if sufficiently powerful engines could be installed. While Savage attack bombers were being constructed, but before any had reached operational units, an order was place with Douglas for two prototypes of its A3D-1 Skywarrior. This attack bomber was to be far larger and heavier than anything built previously for carrier operations. The first prototype flew initially on 28 October 1952 on the power of two pod-mounted Westinghouse J40 turbojets. This engine had been flight tested for the first time only the previous year and had been selected for being then the most powerful turbojet of US manufacture.

Production of the Skywarrior began with 50 A3D-1s, the first of which were delivered in March 1956 and joined the fleet in 1957. Because of development problems with the Westinghouse engine, each A3D-1 had two more powerful Pratt & Whitney J57-P-6 turbojets installed below the shoulder-mounted swept wings. Production of J57s had started in February 1953, just in time to power the first service test A3D-1.

In early 1957 the Pacific Fleet received the first of 164 improved A3D-2s. Each A3D-2 was powered by J57-P-10 turbojets and had a modified 4.57m (15ft) bomb-bay to allow the carriage of a greater variety of weapons. As with the A3D-1, the crew comprised a pilot, co-pilot/bombardier (seated by the pilot) and rear-facing navigator/gunner. Defensive armament was the usual twin 20mm cannon in the rear fuselage, mounted in a Westinghouse Aero 21-B ball turret and radar directed. This version had a maximum take-off weight of 37,195kg (82,000lb), making it the heaviest aircraft ever operated from aircraft carriers, and a maximum speed of 982km/h (610mph) at 3050m (10,000ft). Range was more than 4667km (2900 miles). In 1962 A3Ds were redesignated A-3s. As a small number of A3D-1s had been converted into trial photographic reconnaissance and electronic-countermeasures aircraft, so actual production versions were produced based on the A3D-2. The A3D-2P (later RA-3B) was the photographic-reconnaissance version carrying 12 cameras in a strengthened and completely pressurized fuselage. Length was reduced from 23.27m (76ft 4in) to 23.01m (75ft 6in) and tail armament was retained. The first of 30 flew on 22 July 1958. The A3D-2Q (later EA-3B) was the ECM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Douglas A3D-2 Skywarriors converted as KA-3Bs for operation by squadron VAK-208.

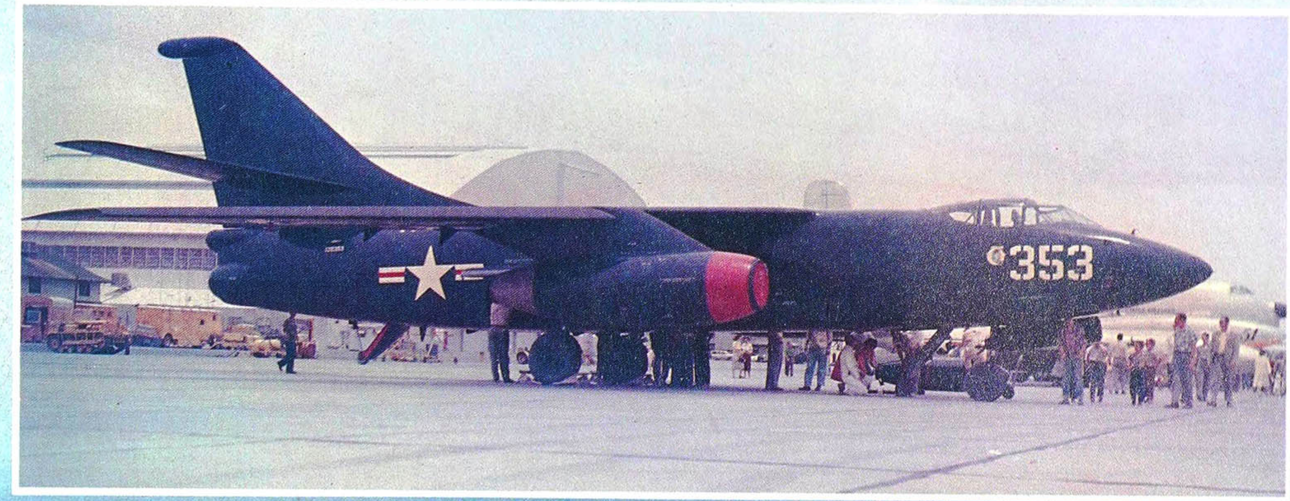
variant, the crew comprising seven persons (four specialists accommodated in a bomb-bay cabin). Twenty-four were produced, the first flying on 10 December 1958. Another variant appeared in 1959 as the A3D-2T navigator and bombardier trainer, accommodating a pilot, an instructor and six pupils. Twelve were built, becoming TA-3Bs in 1962.

By the early 1960s the Skywarrier was at the peak of its service, equipping no less than 18 Navy squadrons. But rapidly the Navy's strategic power was taken away from aircraft carriers and put in less vulnerable submarines, the role of the Skywarrior and deck or ramp-launched Regulus missiles diminishing accordingly. During the Vietnam conflict Skywarriors found new roles, firstly as KA-3B flight refueling tankers and then EKA-3B tanker/countermeasures or strike (TACOS) aircraft, 30 of the latter being produced by conversion. In the early 1980s the US Navy still had EA-3Bs, KA-3Bs and TA-3Bs listed as operational, a total of 58 aircraft.

The second production A3D-1 Skywarrior on display by two other new aircraft, the XB-51 and Douglas C-124 Globemaster II transport.

The small Skyhawk, originally with the A4D designations but from 1962 known as the A-4, was the logical progression of the prewar Devastator, wartime Dauntless and postwar Skyraider, all of which were piston engined. Ordered in prototype form in 1952, Douglas had been able to assess the role of Navy light attack Skyraiders fighting in Korea and the success of jet fighters seen in widespread combat for the first time. The

A-4G Skyhawk, a version of the A-4F for the Royal Australian Air Force and equipped to carry Sidewinder missiles if required.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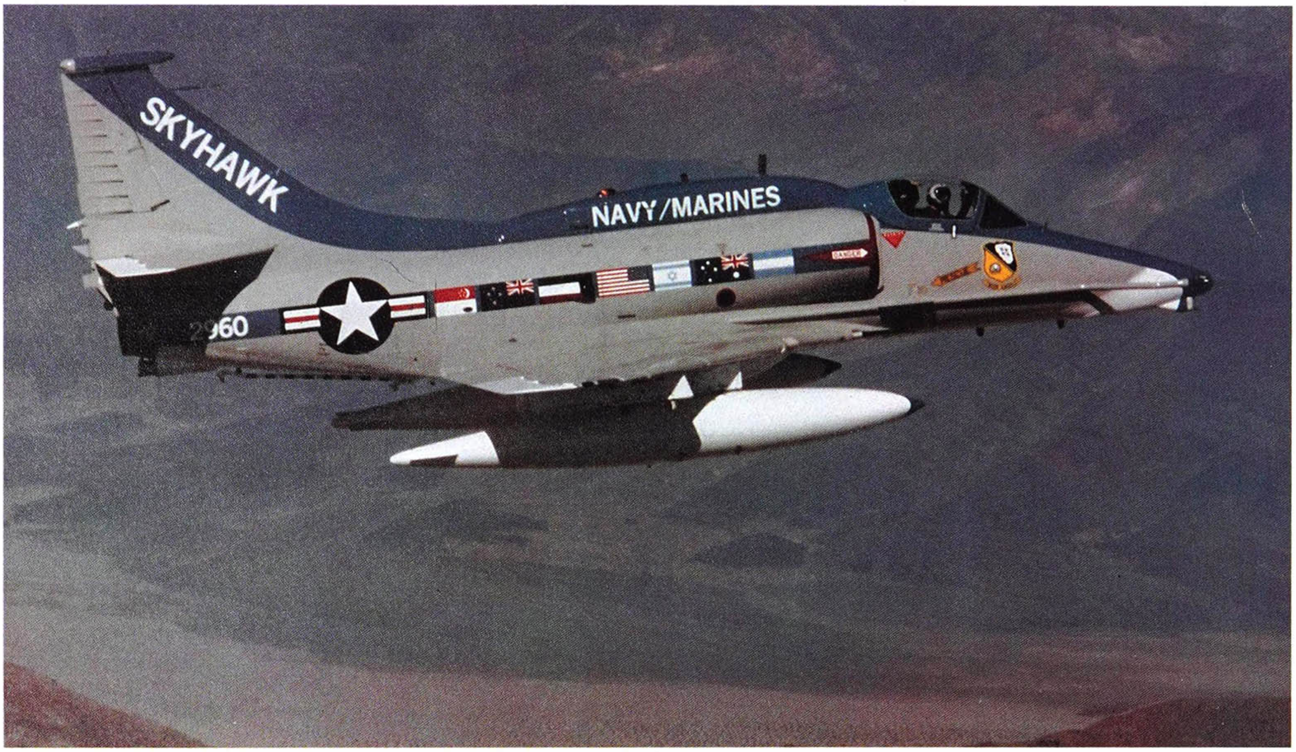

The last of 2,960 Skyhawks built was this A-4M Skyhawk II.

outcome was the design of a single-seat lightweight aircraft suited to all sizes of aircraft carriers and operation from land. Its configuration was that of a tailed delta, with a wing leading-edge sweepback of 33 degrees.

Construction of the XA4D-1 prototype started in September 1953 and it made its maiden flight on the power of a 3265kg (7200lb)st Wright J65-W-2 turbojet engine installed in the rear fuselage on 22 June 1954. Nineteen service test YA4D-1s followed. Actual production began with the A4D-1, fitted with the more powerful 3538kg (7800lb)st J65-W-4 turbojet. The first production aircraft flew initially on 14 August 1954 and the first of 146 entered service with the Atlantic and Pacific Fleets in October 1956. Under the 1962 military designation system, this version became the A-4A.

By the end of production in early 1979, no fewer than 2405 combat Skyhawks and a further 555 tandem two-seat trainers had been built for the US Navy, Marine Corps and for the forces of many other countries. Of the 17 production versions, the A4D-2 (A-4B) with a J65-W-16A turbojet, the A4D-2N (A-4C) with a longer nose to house additional radar for improved all-weather capabilities, the longer-range A4D-5 (A-4E) with a 3855kg (8500lb)st Pratt & Whitney J52-P-6A turbojet and ability to carry an increased weapon-load of 3720kg (8200lb), and the TA-4J trainer were the most produced, with 542, 638, 494 and 291 completed respectively. The A-4M, 162 of which were built, was the first of the improved Skyhawk IIs, powered by a 5080kg (11,200lb)st J52-P408A turbojet. This has a maximum take-off weight of 11,113kg (24,500lb), a maximum speed of 1038km/h (645mph) while carrying a 1814kg (4000lb) warload and a ferry range of 3307km (2055 miles). Total weapon load is 4536kg (10,000lb), which can include conventional and nuclear bombs, missiles, rockets and many other stores. Two wing-mounted cannon are standard.

US Skyhawks were operated widely during the Vietnam conflict. Most recently those in Argentine service took part in the hostilities over the Falkland Islands, their most important victory coming with the sinking of the Royal Navy Type 42 destroyer HMS *Coventry* on 25 May 1982. Between these conflicts Skyhawks of other nations had seen action. Of course other versions of the Skyhawk have been produced by con-

The USMC's OA-4M forward air control Skyhawk.

version, the latest being the USMC's OA-4M, 23 of which were being prepared from two-seat TA-4Fs for forward air control missions.

The aircraft selected to follow on from the Skywarrior as the Navy's heavy attack bomber was the North American A3J Vigilante. This was designed to provide the US Navy with a Mach 2 aircraft of the highest caliber, equal to any land-based attack bomber in the world. A two-seater, its weapon load provided for the carriage of nuclear and conventional bombs in a unique 'linear' bomb-bay plus underwing stores. The bomb-bay comprised a tunnel with rollers inside the rear fuselage, on which bombs could be positioned and later ejected between the engine jetpipes. LABS (low-altitude bombing system) or 'toss' bombing could be employed.

The Vigilante was designed as a high-wing attack bomber with a wing sweep-back on the leading-edge of 37 degrees. Hydraulically-actuated variable-camber leading-edges were fitted in three sections to each wing. Spoilers and underwing deflectors were fitted instead of the usual ailerons, plus flaps. The wings folded to aid on-board stowage.

Prototypes were ordered in 1956 and the first of two took to the air for the first time on 31 August 1958. The A3J-1 (later A-5A) initial production version was, in the event, the only attack bomber, entering service in 1961 and first becoming operational on board the new USS *Enterprise* the following year. *Enterprise* was the US Navy's first nuclear-powered aircraft carrier and the largest warship in the world. Early Vigilantes had two 4695kg (10,350lb)st dry General Electric J79-GE-4 turbojet engines with afterburners installed side by side in the rear fuselage, but these gave way to 4944kg (10,900lb)st dry-rated J79-GE-8s. Production totalled 57 aircraft plus the two prototypes.

A long-range attack bomber had been planned as the follow-on A3J-2 (A-5B), extra fuel being carried in a humped fairing above the fuselage. However, by then Navy deployment plans for the future did not include a requirement for such an aircraft, or indeed the use of an attack bomber of A3J-1 caliber. Therefore, the six initial A3J-2s were modified on the production line into A3J-3s (RA-5Cs) reconnaissance aircraft.

The RA-5C was first flown on 30 June 1962 and yet remained operational until re-

TA-4J two-seat trainer version of the Skyhawk, in service with the US Navy.

The North American Vigilante was the most powerful attack aircraft operated from aircraft carriers, second in size and weight only to the Savage. Here RA-5C reconnaissance aircraft are illustrated, the last Vigilantes in service.


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Grumman A-6E/TRAM Intruder, the US Navy's latest version of this carrier-based attack aircraft.

cently. It was conceived as the airborne component of the Integrated Operational Intelligence System, carrying for its main reconnaissance role tactical sensors and cameras in a long underfuselage fairing. Other items of equipment included side-looking radar and electro-magnetic sensors for countermeasures (ECM) and intelligence gathering. Engines comprised either J79-GE-8s or later 5395kg (11,870lb)st dry J79-GE-10s, bestowing a take-off weight for a normal reconnaissance mission of 30,300kg (66,800lb), a maximum speed of 2228km/h (1385mph), a service ceiling of 15240m (50,000ft) and a range of 4830km (3000 miles). Maximum weight of this version was 36,100kg (79,587lb). The four underwing attachment points for auxiliary fuel tanks could also carry weapons. RA-5Cs were first delivered to the US Navy's training squadron for Heavy Attack Wing One in 1964. The aircraft first became operational on board USS *Ranger* in the South China Sea, equipping Reconnaissance Attack Squadron 5. By 1965 the attack bomber version of the Vigilante had given way completely to the reconnaissance model and eventually Heavy Attack Wing One became known as Reconnaissance Attack Wing One. Further RA-5Cs were built thereafter.

The US Navy's 'A' series for attack aircraft designation covered many varying types, examples already mentioned including lightweight and heavy, medium and long-range, single and multi-engined, and single-seat and multi-seat aircraft. In 1957 Grumman was selected winner of a competition for a new carrier-borne low-level attack bomber, expected to locate and attack enemy targets in all weather conditions and in darkness at long range, and carry a wide variety and heavy load of conventional and nuclear weapons. High subsonic performance was accepted as the most suitable for this penetration role.

The Grumman attack bomber was originally designated A2F-1 Intruder (later A-6 under the 1962 system), the first flying on 19 April 1960. This was one of four initial development aircraft ordered for 1960 and was to be followed by four more in 1961. It was a mid-wing aircraft with just 25 degrees of sweepback at quarter chord, accommodating a crew of two on slightly staggered side-by-side ejection seats. Five attachment points each had a capacity of 1633kg (3600lb), and could carry many combinations of weapons including 30 500lb bombs or Bullpup missiles. Deliveries to VA-42 at NAS Oceana began in February 1963 and the last was accepted in December 1969. A total of 482 was completed for the Navy and Marine Corps. These were widely employed during the Vietnam conflict.

Six converted A-6As subsequently joined 27 newly-built EA-6A Intruders for the new electronic reconnaissance and ECM role, the prototype of which appeared in 1963. A much refined version of the EA-6A subsequently appeared as the EA-6B Prowler. A-6B was the designation of nineteen A-6As modified to carry Standard ARM anti-radiation missiles, to provide the capability of destroying enemy defensive and missile guidance radars. A-6C applied to 12 A-6As modified to carry forward-looking infra-red sensors and low light television camera for night attack.

In 1966 a modified A-6A flew as the KA-6D tanker and 62 were produced in this way. The only new-production version has come in the form of the advanced A-6E Intruder of 1970, carrying multi-mode radar and an IBM computer. Operational since 1972, a total of 318 was expected originally, many produced by converting A-6As but the remainder as new construction. Production was continuing in 1982. A version of the

A-6E with target recognition and attack multisensor equipment first appeared in 1974 as the A-6E/TRAM. This variant can carry laser-guided weapons and first went to sea operationally in 1980. Eventually all A-6Es will have this capability. Maximum take-off weight for the A-6E when operating from an aircraft carrier is 26,580kg (58,600lb), maximum speed is 1037km/h (644mph) and range 5222km (3245 miles). Maximum weapon load is 8165kg (18,000lb), made possible by two 4218kg (9300lb)st Pratt & Whitney J52-P-8B turbojet engines.

Grumman Intruder, Prowler (2nd aircraft) and other types on board USS *John F. Kennedy* in 1978.

A-7As on board USS *Midway* in 1975, operated by VA-93.

In 1964 the US Navy announced that LTV had won a competition for a single-seat, carrier-based light attack aircraft designed as a subsonic replacement for the Skyhawk. Later known as the A-7 Corsair II, it had been based on the company's earlier F-8 Crusader fighter, although shorter in length and without the fighter's unusual wing. The first development aircraft flew initially on 27 September 1965. In 1967 A-7A production aircraft became operational, immediately going into action over Vietnam.

The A-7A used a non-afterburning Pratt & Whitney TF30-P-6 turbofan engine with a

thrust of 5148kg (11,350lb). A total of 199 was built. Follow-on versions were built for the Navy, plus land-based A-7Ds, with Allison TF41-A-1 engines for the USAF and A-7Hs for the Hellenic Air Force, and two-seat trainers. Portugal has also received A-7Ps, which are refurbished A-7As. The last Navy version was built as the A-7E for attack, close support and interdiction, which went out of production in 1981 after 596 had been built. Powered by a 6803kg (15,000lb)st Allison TF 41-A-2 turbofan, it can carry more than 6803kg (15,000lb) of weapons on eight

Above: USAF A-7D armed with fifteen 750lb general-purpose bombs.

An LTV A-7A Corsair II of VA-147, taking off carrying Snakeye bombs. VA-147 was the first operational A-7 squadron.


ENGINE INTAKE
ENGINE INTAKE

Above: *XK490*, one of the first twenty Buccaneer S.Mk 1s for the Royal Navy, seen flying over a Folland Gnat during a Farnborough air display.

external stations. Maximum take-off weight is 19,050kg (42,000lb), maximum speed 1112km/h (691mph) and maximum ferry range 4604km (2861 miles).

A French-built, carrier-borne aircraft that caused much damage to British Task Force vessels during the recent conflict over the Falkland Islands is the Dassault-Breguet Super Etendard. Carrying Exocet anti-shipping missiles, Argentinian Super Etendards operated from the mainland. However, as the Super Etendard is a Mach 1 strike fighter and can carry air-to-air armament as well as bombs, rockets and other missiles (French Navy aircraft also have provision for tactical nuclear weapons), it was included in *Jet Fighters*.

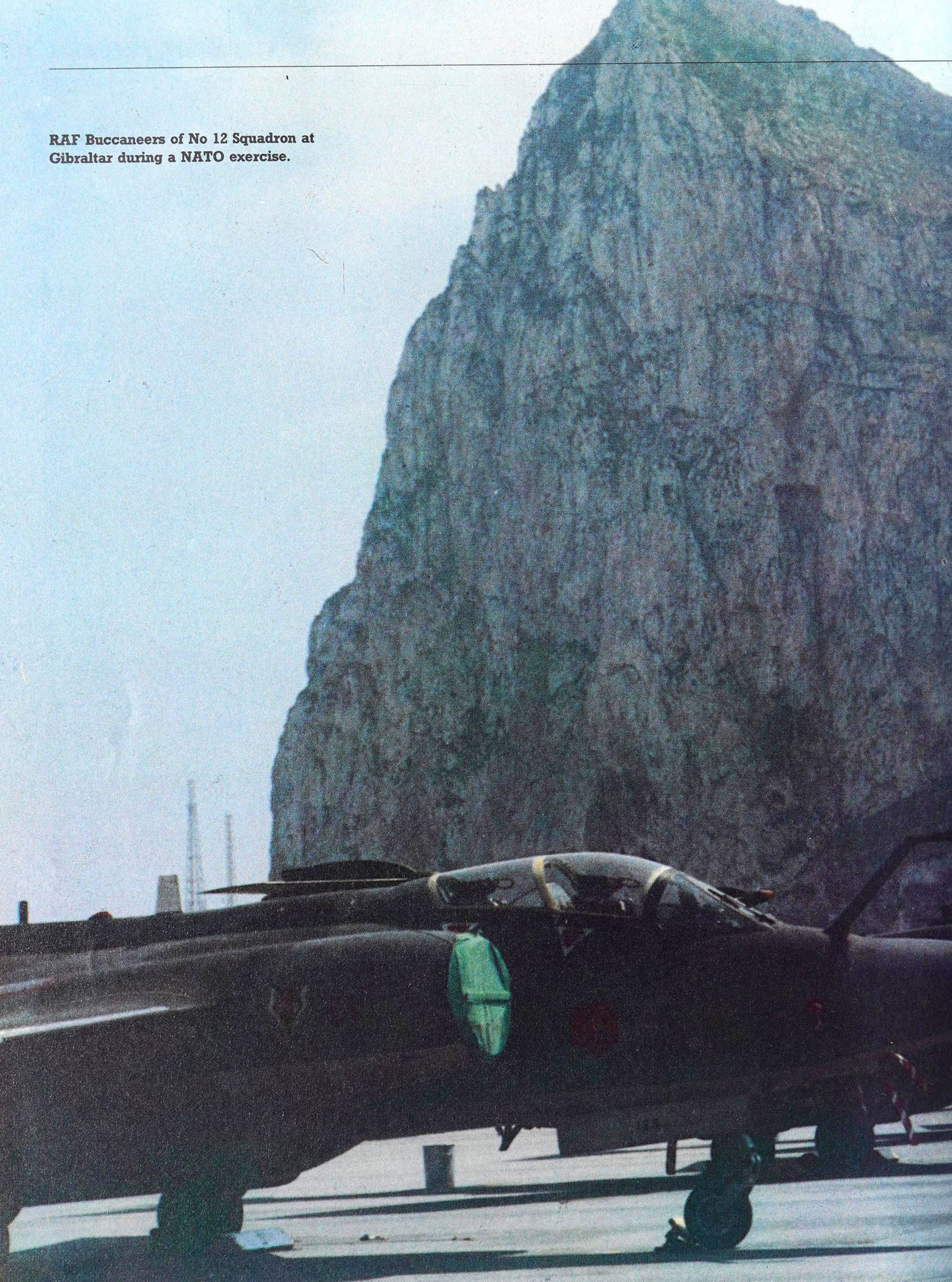
Until HMS *Ark Royal* was scrapped, the Royal Navy operated the two-seat carrier-borne low-level Hawker Siddeley Buccaneer strike aircraft. Others were in service with the RAF and South African Air Force as land-based aircraft. It was the former of these that took over naval Buccaneers when the Royal Navy became a V/STOL fixed-wing aircraft force operating Sea Harriers, and these continue in service.

Originating as the Blackburn B.103 and conforming to Naval Specification NA 39, the Buccaneer was first flown on 30 April 1958. The first version was the Royal Navy S.Mk 1, with two 3220kg (7100lb)st Bristol Siddeley Gyron Junior turbojet engines housed in nacelles on each side of the fuselage. The mid-mounted wings were swept at 40 degrees at the root. The first of forty production S.Mk 1s flew on 23 January 1962 and No 801 Squadron (the first Navy Buccaneer squadron) embarked on board HMS *Ark Royal* in early 1963.

French Navy Dassault-Breguet Super Etendard, one of the most widely known naval aircraft following its use by Argentina during the Falklands conflict. This Super Etendard carries an Exocet.

The Buccaneer S.Mk 2 was the developed version with Rolls-Royce RB.168 Spey turbofan engines and extended wing-tips, production aircraft appearing from 1964. A total of 84 was built, entering Royal Navy service from 1965. Royal Navy Buccaneers later became known as S.Mk 2Cs and S.Mk 2Ds, the latter designation indicating a capability to carry Martel air-to-surface missiles. Meanwhile, Buccaneer production for the RAF had begun, No 12 Squadron becoming the first operational RAF unit with the S.Mk 2B in 1970. This version was given Martel capability and 43 operational examples were built as new. As the Royal Navy disposed of its Buccaneers, so many became RAF S.Mk 2As (without the ability to carry Martel) and S.Mk 2Bs. The RAF's Buccaneers with 5035kg (11,100lb)st RB.168-1A Spey Mk 101 turbofans can carry a weapon load of up to 7257kg (16,000lb). Maximum speed at 60m (200ft) altitude is 1038km/h (646mph) and range for a typical sortie is 3700km (2300 miles).

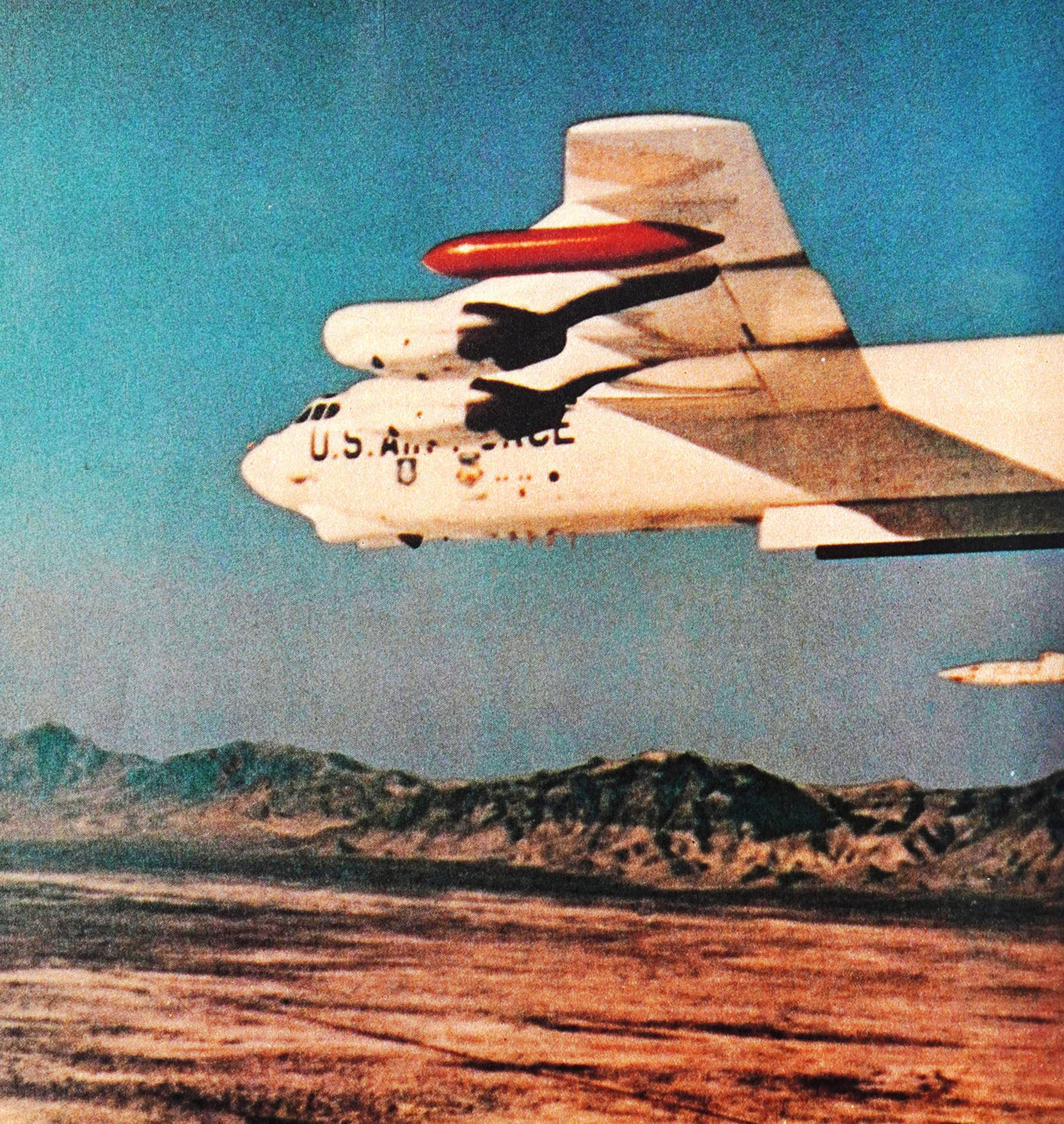
Buccaneer S.Mk 1 on board a Royal Navy aircraft carrier.

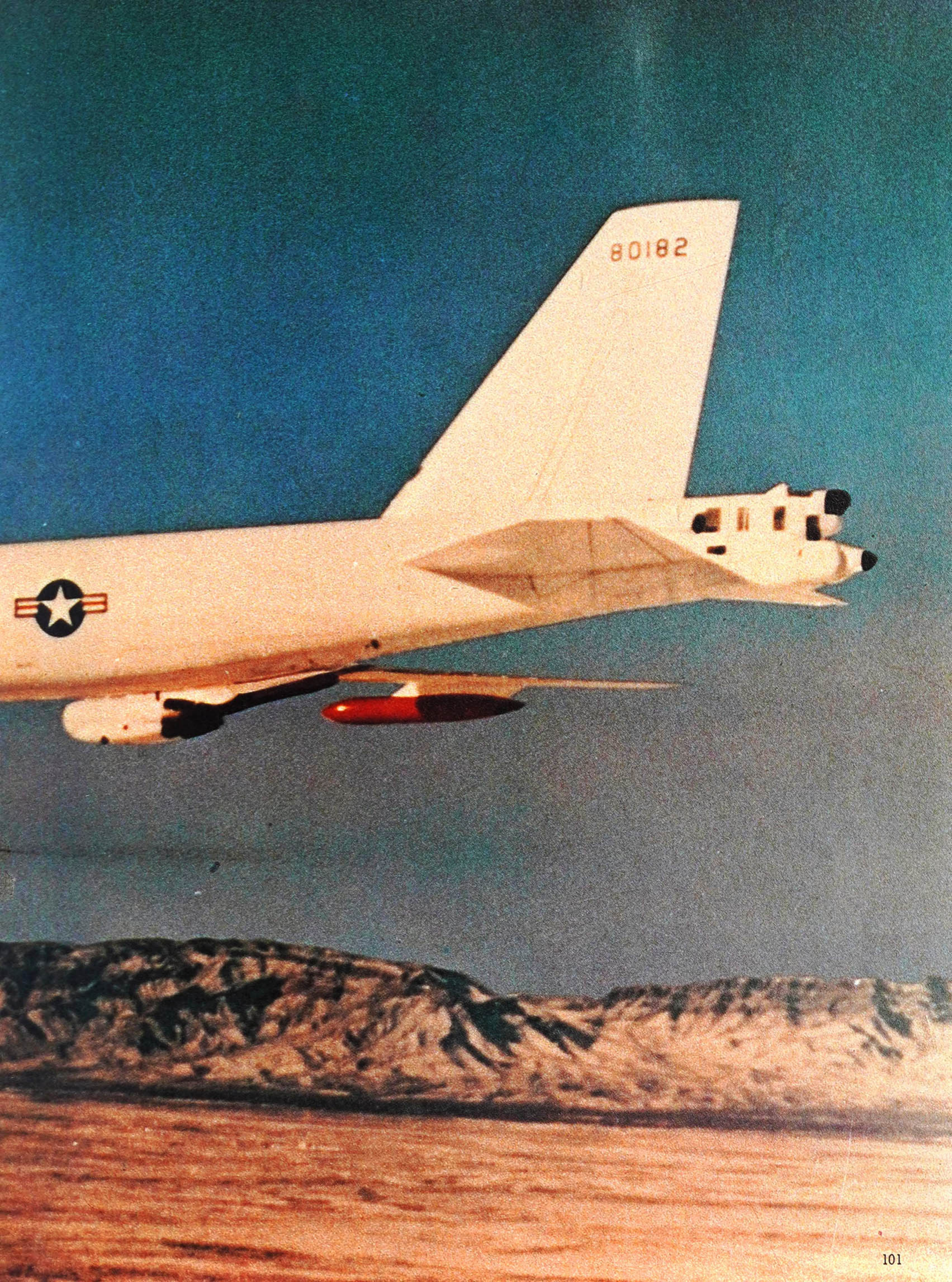


RAF Buccaneers of No 12 Squadron at Gibraltar during a NATO exercise.

RAF Buccaneer S.Mk 2B capable of carrying Martel air-to-surface missiles.

6: WIELDING THE BIG STICK

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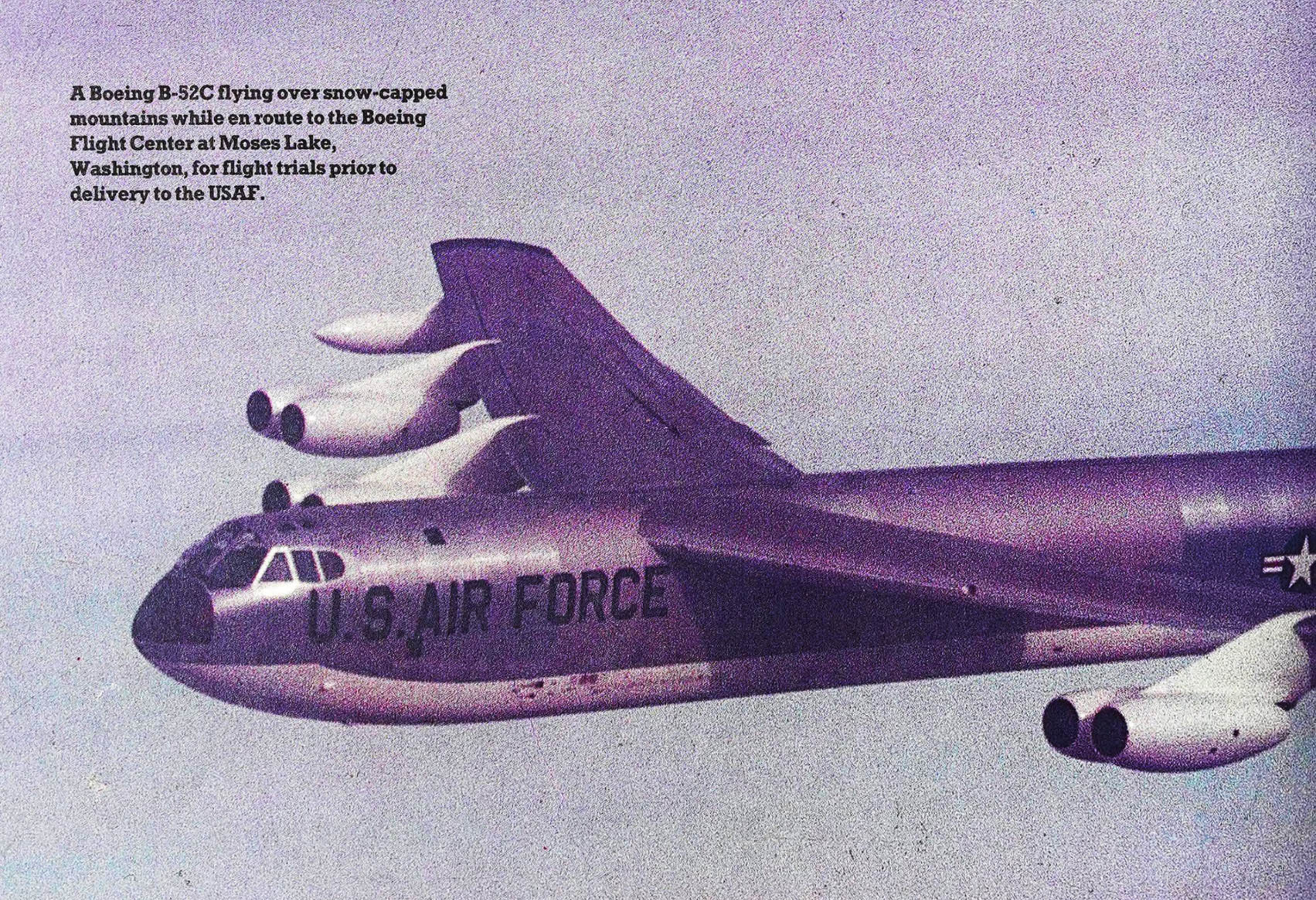
By the late 1940s both the United States and the Soviet Union had developed multi-engined jet bombers well suited to tactical roles. But political divisions around the world demanded that the same type of modern powerplant be applied at the earliest possible time to strategic bombers with intercontinental range.

Turbojet engines capable of producing high thrust were available. The main problem was that while a sufficient number of turbojet engines matched to a high-technology airframe could produce an aircraft with good speed and weapon carrying capability, no such guarantees could be given for range. Despite great advances in design and development since the war, turbojets were still very fuel thirsty.

One answer was not to adopt turbojet engines for a jet bomber but turboprops and it was on this type of engine that both nations originally conceived strategic jet bombers. Prior to the USAF receiving production versions of the Boeing B-50 and Convair B-36 piston-engined strategic bombers, Boeing proposed an entirely new aircraft with straight wings and six Wright XT35 turboprop engines. The XT35 was then under development and was expected to produce 5500shp. Flight testing of the engine mounted in the nose of one of two B-17Gs used by the Wright Aeronautical Corporation as Model 2997Zs began in September 1947, by which time the 1946 proposal had been modified to incorporate swept wings following a visit to Germany by Boeing engineers. This new configuration appeared to offer a high performance and good range and in July 1948 Boeing received a contract to build two prototypes of its Model 464 for the USAF.

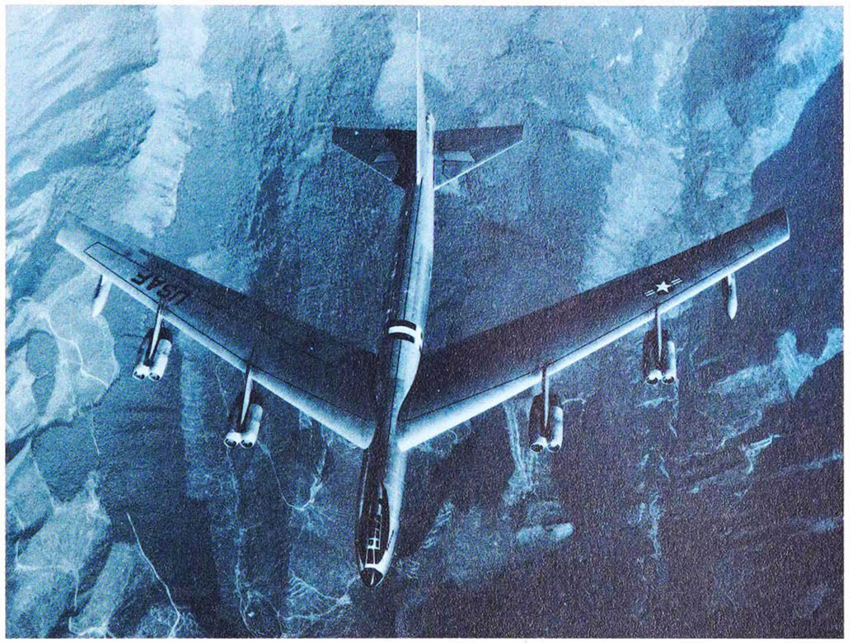
Meanwhile Boeing had flown and tested its prototype B-47 Stratojet medium bomber. The excellence of this with its 35 degrees of wing sweepback and six turbojet engines convinced the company that a similar approach was feasible for the Model 464. With the agreement of the USAF, the Model 464 were redesigned to incorporate a sweep of 35 degrees and eight 3946kg (8700lb)st Pratt & Whitney J57-P-1W turbojet engines carried in pairs on underwing pylons. In this configuration and with a B-47-style bubble canopy for the pilot and co-pilot in tandem, the two aircraft ordered were built, one as the XB-52 and the second as the YB-52 Stratofortress. The first to fly was the YB-52, taking to the air for the first time on 15 April 1952. The XB-52 followed on 2 October of the same year.

The initial production variant was the B-52A, powered by J57-P-9W engines. The



A Boeing B-52C flying over snow-capped mountains while en route to the Boeing Flight Center at Moses Lake, Washington, for flight trials prior to delivery to the USAF.

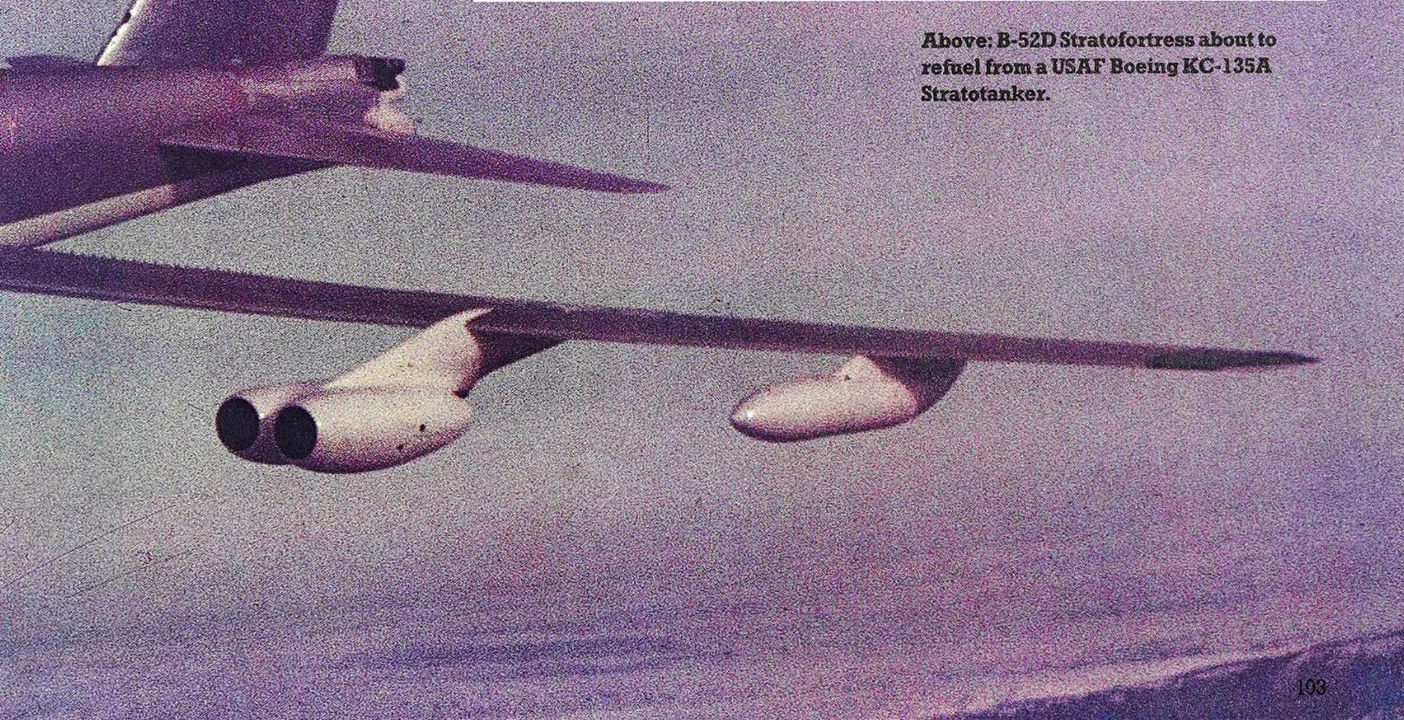
Previous page: A B-52G releases an air-launched cruise missile during development trials.

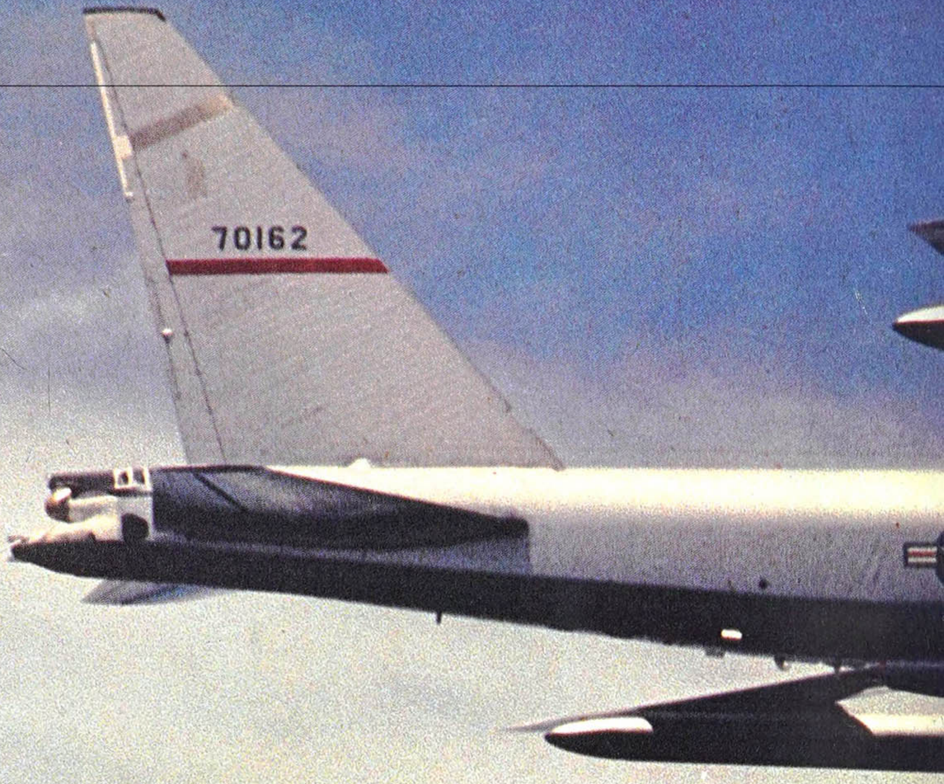


This view of the Boeing YB-52 shows clearly the tandem arrangement for the pilot and co-pilot under a bubble canopy.

most obvious external change to the prototypes was the new stepped cockpit for side-by-side accommodation of the pilot and co-pilot. Thirteen of these were to be built, but in the event only three were completed. The first flew initially on 5 August 1954. The remaining 10 from the first order were included in the total of 50 B-52Bs completed. In fact the 'B' was built in two subvariants, the standard B-52B and the RB-52B with strategic bombing capability and the ability to carry a pressurized and manned capsule in the bomb-bay for strategic photographic reconnaissance and electronic countermeasures roles. Powered by J57-P-19W, -29W or -29WA turbojets, 23 B-52Bs and 27 RB-52Bs were completed.

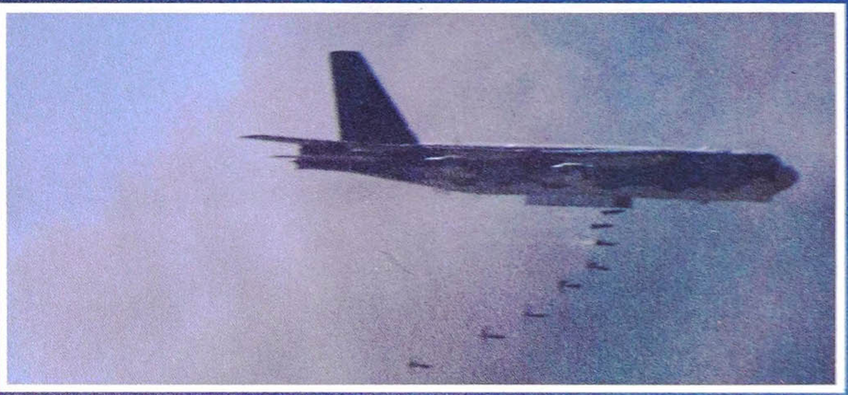
Above: B-52D Stratofortress about to refuel from a USAF Boeing KC-135A Stratotanker.





A mock-up of the new non-nuclear General Dynamics AGM-109H Tomahawk II cruise missile is displayed in front of a B-52D at March AFB.

Boeing B-52F releases fifty-one 750 lb bombs over a target in South Vietnam.

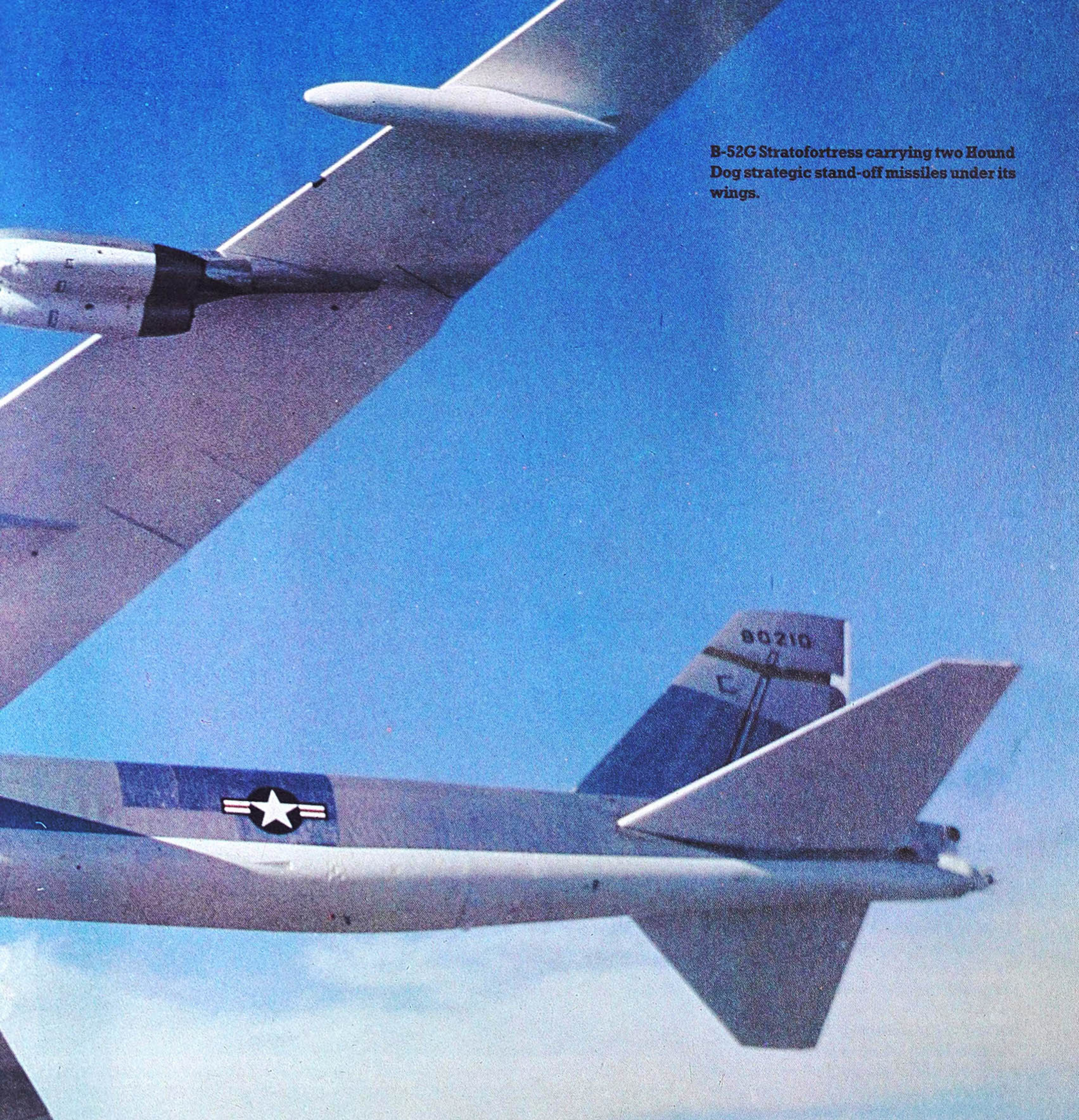


One of six B-52s, from the 5th and 39th Bomb Wings that flew non-stop from North Dakota to Egypt and back during exercise Bright Star 82, dropping 500lb retarded bombs.

The 500lb retarded bombs explode on the desert sand.

One each of the first two production versions were subsequently set aside from their strategic role and converted to be NB-52A and NB-52B 'motherplanes' for the air-launched North American X-15 hypersonic aircraft research program, taking off with an X-15 under a wing for the first time on 10 March 1959. Meanwhile other versions of the Stratofortress had entered production. The B-52C was first flown on 9 March 1956. Thirty-five were eventually built with 4536kg (10,000lb)st J57-P-29W engines. The B-52D was first flown on 4 June 1956 and 170 were eventually completed with -19W or -29W engines. The B-52E with improved bombing, electronics and nagivation systems was flown on 3 October 1957 and 100 were built, followed by the B-52F 89 of which were completed with -43W engines of 6237kg (13,750lb)st.

The B-52G was the major production version of the Stratofortress, 193 of which were built between 1958 and 1961. Developed from the 'F,' it had a greatly increased range largely thanks to its redesigned wings with integral fuel tanks, a shorter tail fin and rud-

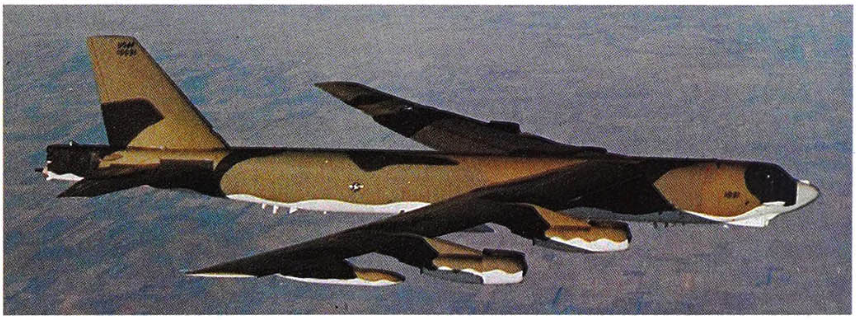


B-52G Stratofortress carrying two Hound Dog strategic stand-off missiles under its wings.

der, a new pressure cabin for the tail-gunner to operate (for the first time by remote control) the four 0.50-in machine-guns in the tail, and other refinements. Whereas the previous versions had been expected to carry up to 27,215kg (60,000lb) of conventional or nuclear weapons in the fuselage bay, the B-52G introduced the AGM-28 Hound Dog and ADM-20 Quail missiles. Hound Dog was a J52 turbojet-powered air-to-surface strategic stand-off missile, carrying a thermonuclear warhead and possessing a speed and range of Mach 2 and 965km (600 miles) respectively. Quail, unique among missiles, was an unarmed decoy, designed to be launched in enemy airspace to give off a radar signal similar to that of a B-52 and so confuse defenses. Two Hound Dogs and four Quails were standard. The first B-52G took to the air initially on 26 October 1958 and entered USAF service in February 1959. Hound Dog followed in December.

The final version of the Stratofortress was the B-52H, powered by eight 7711kg (17,000lb)st Pratt & Whitney TF33-P-3 turbo-

Above: Between the fuselage of this B-52H and each inboard pair of engines are carried two Skybolt missiles.



Right: The final production version of the Stratofortress was the B-52H. This B-52H is not carrying any external stores, although the single 20mm Vulcan multi-barrel tail cannon can be seen.

fan engines. This version was expected to carry the Skybolt strategic missile and had a 20mm Vulcan multibarrel cannon in the tail. When Skybolt was cancelled, it reverted to Hound Dogs and Quails. Production totalled 102, the first flying on 6 March 1961. The final B-52 Stratofortress, a B-52H, appeared in mid-1962 and joined the USAF in October. This, with the 'G', is the heaviest version, at a maximum take-off weight of more than 221,350kg (488,000lb). Maximum speed is 957km/h (595mph) and unrefueled range is more than 16,093km (10,000 miles).

Stratofortress carried out many missions

Right: B-52G Stratofortress with its external load of twelve SRAM missiles visible under the wings.

with heavy loads of conventional bombs during the Vietnam conflict, operating from Guam and Thailand. Thereafter, and with the first of its expected replacement bombers already cancelled, it underwent the first of several rebuilding programs to allow extended service. Two hundred and eighty-one "G"s and "H"s were eventually rearmed with SRAMs (Short Range Attack Missiles), each B-52 carrying eight in the bomb-bay on a rotary launcher and 12 under the wings, plus free-fall nuclear bombs. Other programs have introduced many new electronic and other systems. Very recently the first of an expected total of 173 B-52Gs reentered USAF service equipped to carry and launch 12 AGM-86B cruise missiles, in addition to internally-carried SRAMs and bombs. B-52Hs may also be similarly converted at a future date. Currently the USAF has 347 Stratofortresses in operational service, comprising 269 B-52Gs and Hs and 78 B-52Ds. Whether these remain operational until the end of the century to be the first combat aircraft in aviation history to complete 45 years of first-line service will have to be seen. It largely depends on the deployment of the B-1B replacement.

Top: Eight SRAM missiles on their rotary launcher being prepared for the bomb-bay of a B-52G.

Above: The latest missile developed for the B-52 is the Boeing AGM-86B air-launched cruise missile. Here twelve are carried during development trials.

In 1946 the Soviet Union produced the first examples of its Tupolev Tu-4. Subsequently known to NATO as *Bull,* it was based on the US piston-engined Boeing B-29. By the latter 1940s it had become clear that a successor was required urgently. Among those proposed were the Tupolev Tu-80 and refined Tu-85. Both were based on the Tu-4 and retained piston engines. Prototypes appeared in 1949 but these were not what was needed, and Stalin for one let this be known. However, already early work on turbojet-powered Tu-4 replacements were in design and, while waiting for these would mean delay, the prospect of the increased performance was persuasive.

Two main contenders for the smaller twin-engined replacement were produced as prototypes, the Ilyushin Il-46 and the Tupolev Tu-88 first flying in 1952. The former was an enlarged derivative of the successful Il-28. Considering the backing that the Il-28 had received from Stalin, Ilyushin must have been confident of success. This was not to be the case. The Tu-88 was a much more modern aircraft, perhaps surprisingly so considering Tupolev's earlier proposals. Roughly in the class of the US Boeing B-47 Stratojet but even more advanced, it had swept back wings and tail surfaces and two large but simple high-thrust Mikulin AM-3 axial-flow turbojet engines semi-recessed into the fuselage.

As the Tu-16, the bomber was selected for service and entered production in 1953. This first production variant was given the reporting name *Badger-A* by NATO and took part in the May Day flypast of 1954. It was a strategic bomber, with a stepped cockpit for the pilot and co-pilot and a glazed nose for the navigator. The three other crew members were gunner/observers. A small radome was housed under the nose. Defensive armament comprised 7 23mm NR 23 cannon in nose, dorsal, ventral and tail positions. Bombload was an impressive 9000kg (19,842lb).

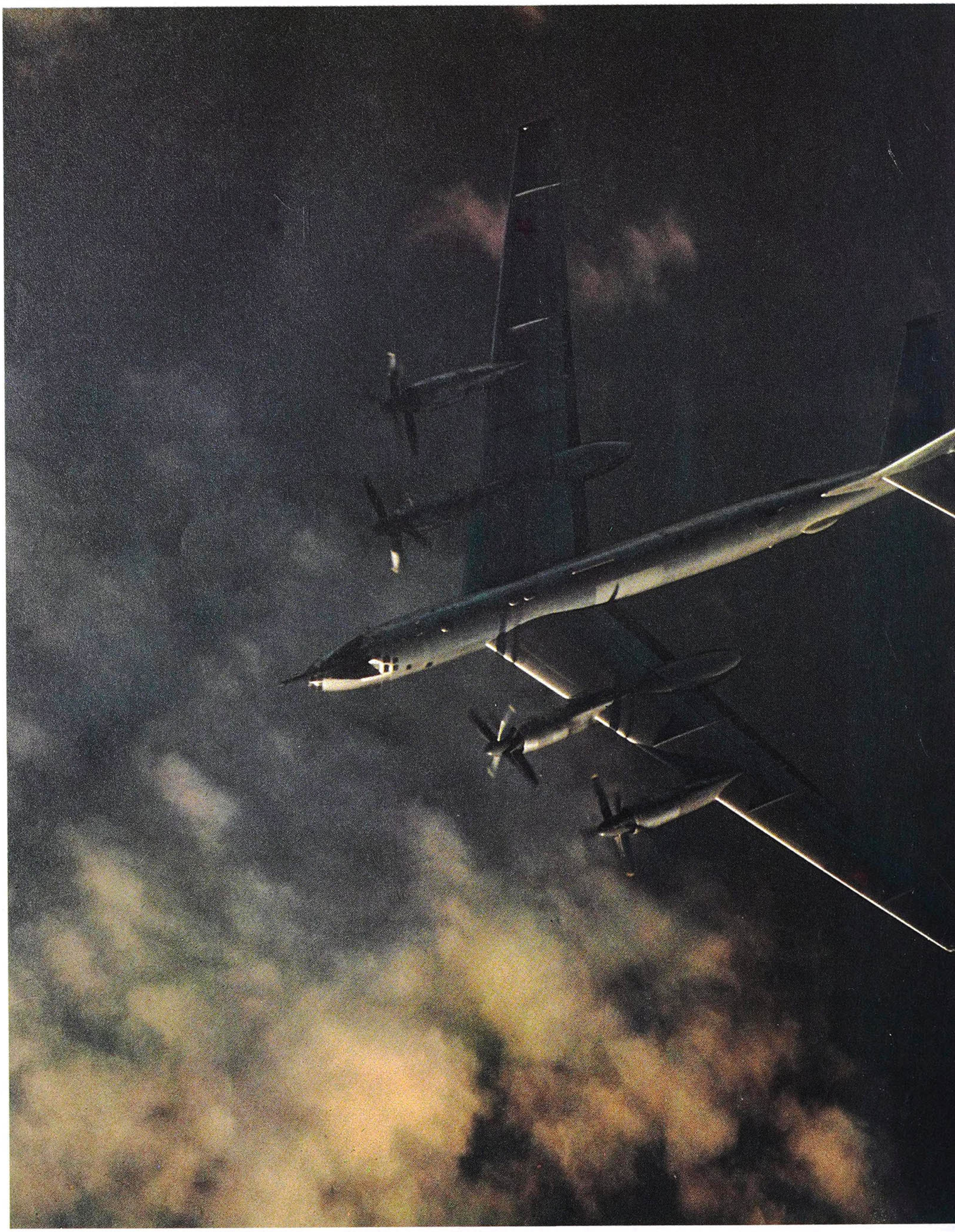
Before production ended in the Soviet Union in the 1960s, it is thought likely that approximately 2000 were built. Identified versions with their NATO reporting names that followed *Badger-A* were the *Badger-B* bomber carrying two *Kennel* 100km (63 mile) range antishipping missiles; *Badger-C* antishipping aircraft carrying either *Kipper* or later *Kingfish* nuclear or conventional missiles; *Badger-D* maritime and electronic reconnaissance aircraft with a larger undernose radome and other fairing for electronic equipment; *Badger-E* photographic reconnaissance aircraft; *Badger-F* photographic reconnaissance and electronic intelligence aircraft; *Badger-G* bomber with *Kelt* 160km (100 mile) range stand-off missiles or *Kingfish* and conventional or nuclear bombs; *Badger-H* and *Badger-J* ECM jamming aircraft to escort and protect armed aircraft; and *Badger-K* electronic reconnaissance aircraft.

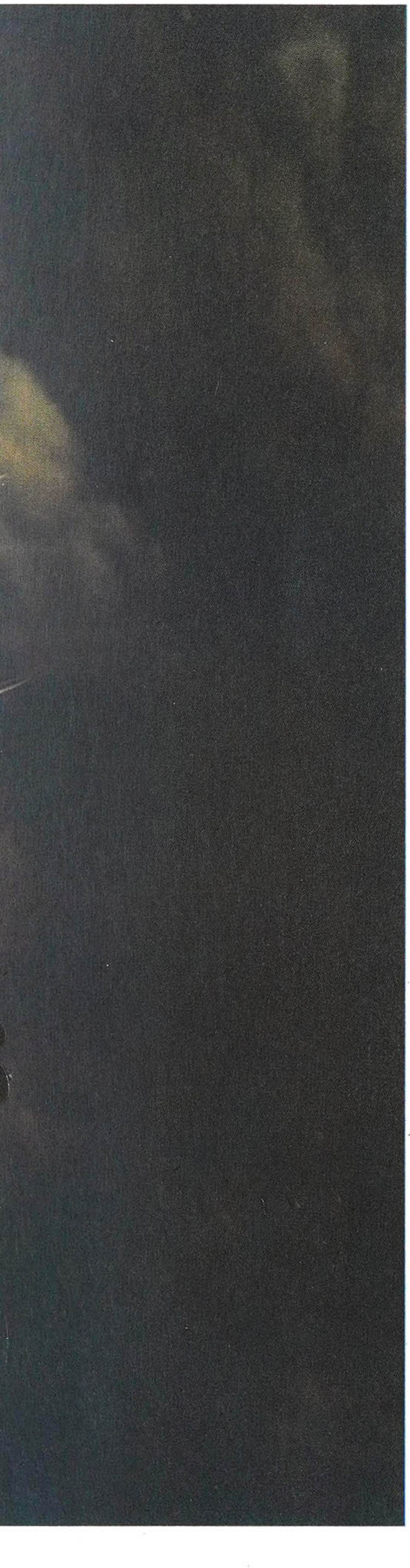
Badger has a take-off weight of approximately 72,000kg (158,730lb). Its maximum level speed on the power of two 8750kg (19,290lb)st AM-3 engines is 992km/h (616mph) and range with a 3790kg (8360lb) bombload is 4800km (3000 miles). Later aircraft were installed with more powerful 9500kg (20,944lb)st RD-3M turbojets.

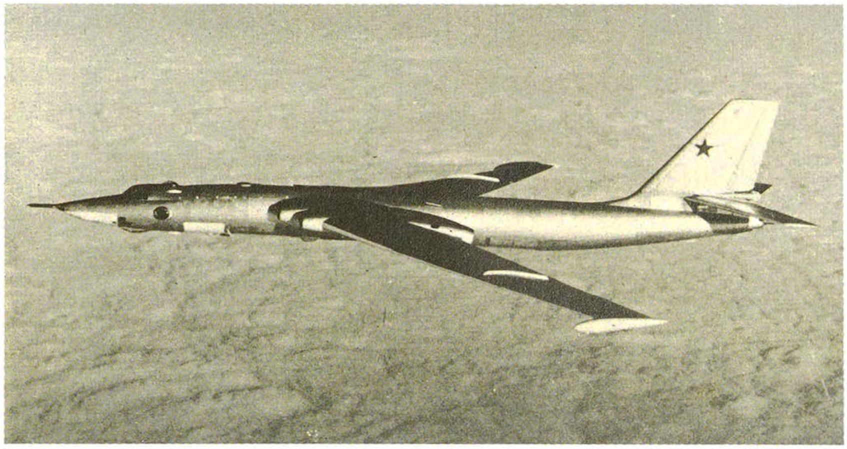
Today it is believed that just over 800 *Badgers* remain in service with the Soviet Dalnaya Aviatsiya (long range air force) and Naval Aviation. These include *Badger-Bs*, now without missiles but carrying nuclear or conventional bombs, other strategic and strike versions and approximately 125 air force and 110 naval ECM, reconnaissance and flight refueling tanker aircraft. In addition, Egypt and Iraq deploy bombers and China operates approximately 100 as locally-built Xian H-6s. Production in China continues.

An Egyptian Air Force Tupolev Tu-16 *Badger* bomber armed with a *Kelt* air-to-surface stand-off missile.

Inset: Soviet Naval Aviation Tu-16 *Badger* on a maritime reconnaissance mission.







Above: Soviet Naval Aviation Myasishchev M-4 *Bison-C*.

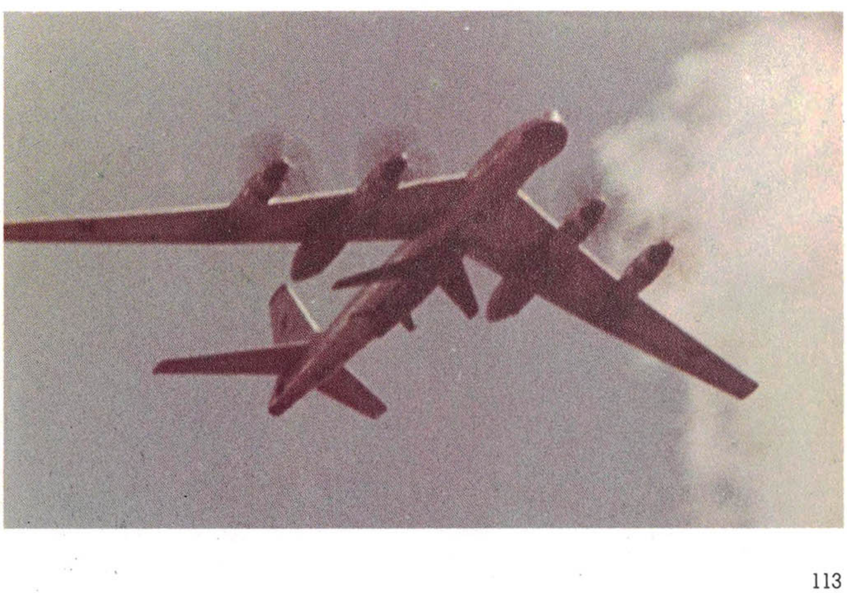
Left: This view of a Soviet *Bear* gives a good indication of its configuration.

True intercontinental strategic capability came to the Soviet Union with the development of the Myasishchev M-4 and Tupolev Tu-95, known to NATO by the reporting names *Bison* and *Bear*. These were developed as 'heavies' to complement the much lighter and less formidable Tu-16 and as such were as much Tu-4 replacements. Superficially the M-4 and Tu-95 were similar, both having wings with approximately 37 degrees of sweepback and swept tail surfaces. However, there was a fundamental difference between the two aircraft, which was to rob the M-4 of the operational performance enjoyed by the Tu-95.

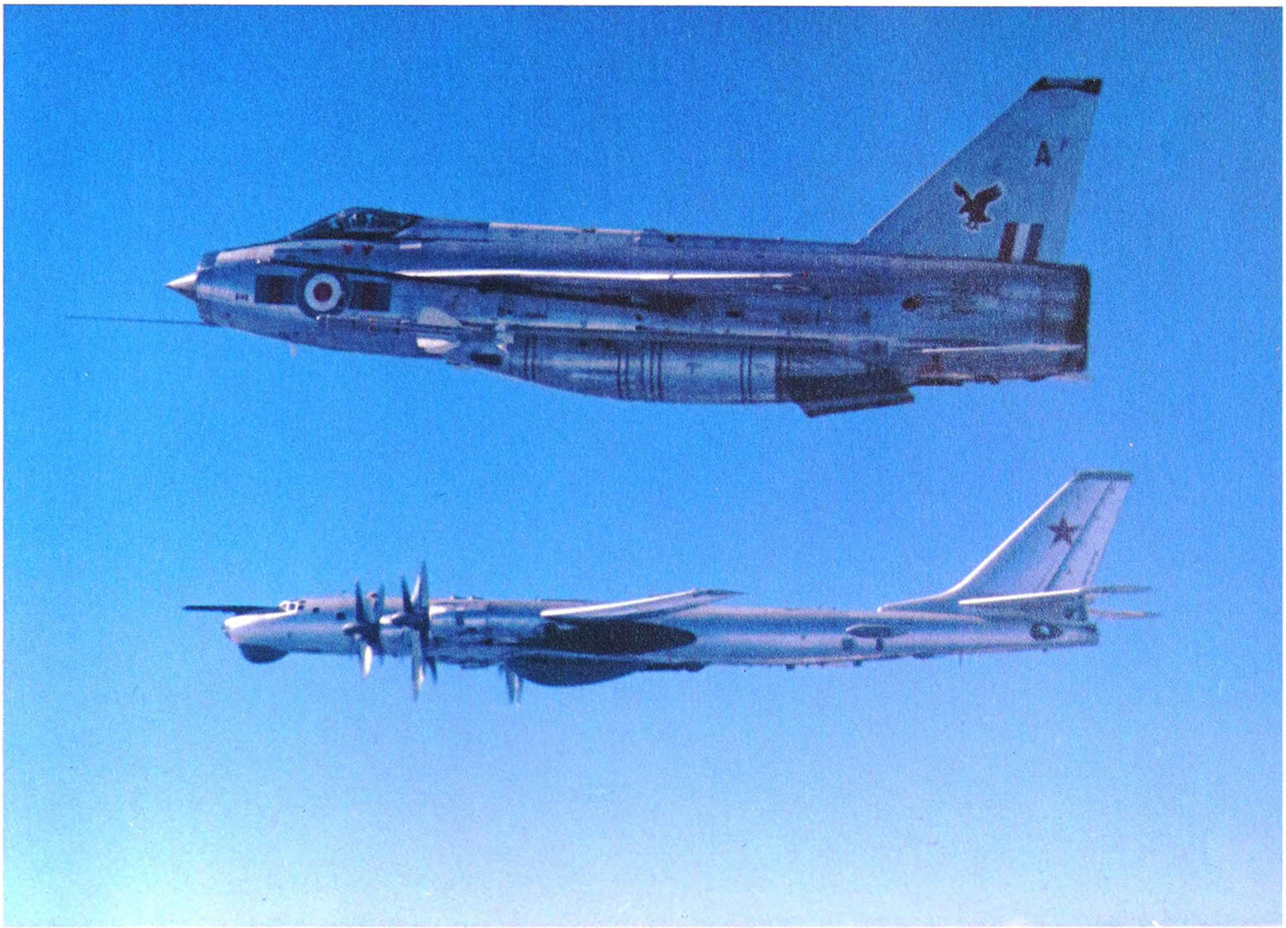
Soviet Dalnaya Aviatsiya Tupolev Tu-95 *Bear-B* long-range bomber carrying under its fuselage a large *Kangaroo* air-to-surface strategic missile.

One of the most important requirements for new bombers was that of extremely long range, sometimes quoted at 16,000km (9942 miles). The first of the two aircraft to appear was the Myasishchev M-4, the design of which had been completed is 1952 and the prototype flew over Moscow during the May Day flypast exactly two years later. It was powered by four Mikulin AM-3D turbojets carried as podded pairs in the wing roots, each rated at 8700kg (19,180lb)st.

The first version, which was the first Soviet production four-turbojet bomber, was given the reporting name *Bison-A* by NATO. This was a bomber carrying conventional or nuclear free-fall bombs. Although possessing a good maximum speed for a huge aircraft of this period – 1000km/h (620mph) – it range fell well short of that required and is now estimated at 8000km (4971 miles) while carrying a 5500kg (12125lb) bombload. Its service ceiling was also disappointing at only about 13,700m (45,000ft), necessitating a defensive arma-




U.S. AIR FORCE
U.S. AIR FORCE



A Soviet Naval Aviation Tu-142 *Bear-D* being escorted back to sea by an RAF Lightning interceptor of No 23 Squadron.

ment of 10 23mm cannon. Maximum take-off weight (estimated, as are the other figures quoted) is 158,750kg (350,000lb). Today the Dalnaya Aviatsiya still includes approximately 45 M-4s in bomber configuration, and a further 35 are thought to be used as flight refueling tankers.

Two other versions of the M-4 were produced for Soviet Naval Aviation. *Bison-B* and *Bison-C* were maritime reconnaissance-bombers, with solid noses replacing *Bison-A's* hemispherical, lightly-glazed nose and other changes including reduced armament. *Bison-C* was the heaviest of all M-4 versions and possessed the highest performance, its maximum speed being estimated at 1060km/h (658mph) and service ceiling at 15,600m (51,180ft). Neither maritime version is thought to be operational.

***Bear-F* photographed as it is being escorted away by USAF Phantom II fighters in September 1980.**

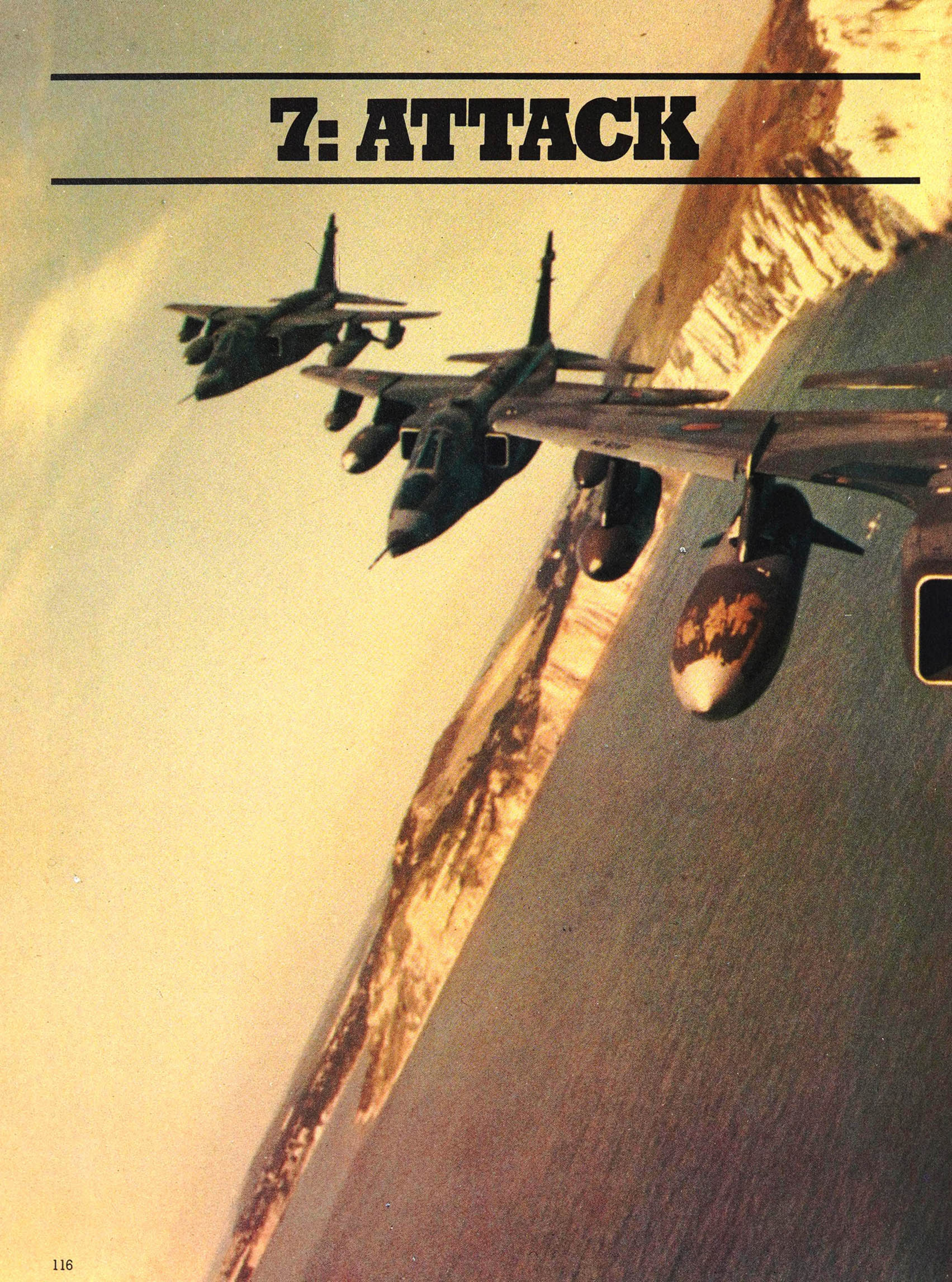
Far more significant to the Soviet air forces is the Tupolev Tu-95, which first flew as a prototype in the latter part of 1954 and could be seen in the sky over Tushino in July of the following year. Unlike the M-4, this aircraft had been designed to use four huge turboprop engines driving contrarotating propellers, these being 14,795shp Kuznetsov NK-12MVs. The engine was then, and is still, the most powerful turboprop ever built, its development being aided by German engineers working in the Soviet Union. It has a 14-stage axial-flow compressor and has a dry weight of 2350kg (5,181lb). Incredibly, because of the excellence of this engine, both this and the Tu-95 are still built today to maintain the number of operational aircraft.

The first version of the Tu-95 to enter service with the long range air force was given the reporting name *Bear-A* by NATO. This is a strategic bomber with a maximum speed of 925km/h (575mph) and a maximum range while carrying a full load of 11,340kg (25,000lb) of conventional or nuclear weapons of 12,550km (7800 miles). It carries six 23mm cannon for defense. The *Bear-B* and *C* were first seen in the early 1960s and carry as their primary armament either a 650km (400mile) range *Kangaroo* or 300km (185 mile) range *Kitchen* supersonic missile, designed to carry out strategic and stand-off attacks on surface targets. *Bear-C* is operated by Naval Aviation and as such carries the type designation Tu-142.

Bear-D differs from previous versions of *Bear* in so much as its main role with Naval Aviation is to relay targeting information to missile-carrying aircraft and ships. For this purpose it carries an X-band radar housed in an underfuselage radome and various other items of equipment in smaller fairings. *Bear-E* is a naval maritime reconnaissance aircraft with up to seven camera windows, and *Bear-F* is a naval antisubmarine strike aircraft.

Despite the continuing deployment of the supersonic Tu-22M *Backfire, Bear* remains vitally important to both the Dalnaya Aviatsiya and Naval Aviation, which operate approximately 109 and 95 respectively. However, with the development of the latest Soviet strategic bomber, the extremely formidable Mach 2.3 *Blackjack,* the longserving and versatile *Bear's* days could be numbered.

7: ATTACK



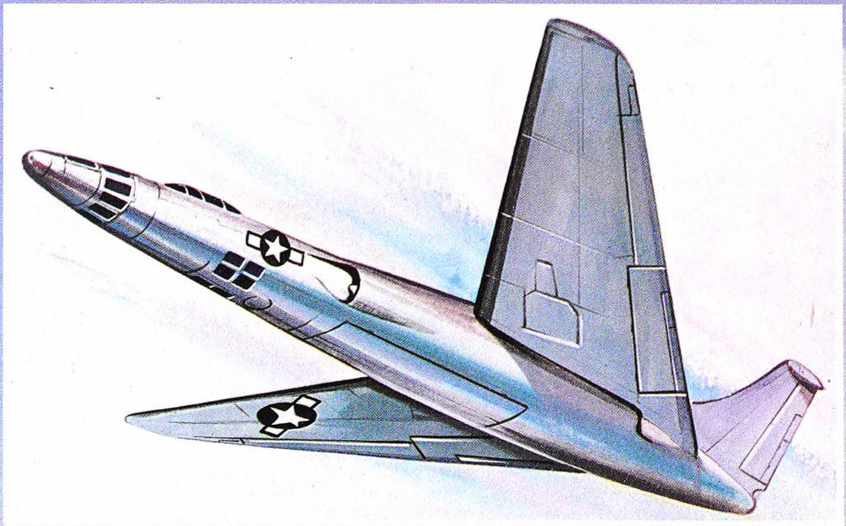
While the first jet bombers were appearing in the United States, thought was also being given to smaller jet-powered attack aircraft. In many respects these were designed to fulfill a role initiated by the Douglas XB-43 and, like its predecessor, at first carried 'A' (attack) Air Force designations.

After the A-42, which became the XB-42, came numerically the Curtiss A-43. This designation was applied to a side-by-side two-seat all-weather aircraft powered by four Westinghouse J34-engines that subsequently became the XF-87 fighter. This was first flown in February 1948. The A-44 was the original designation of what became the XB-53, a bold design by Convair for a light attack bomber of high performance, which unlike the XF-87 was never built. Development funds for the XA-44 were in fact drawn from the XB-46 project and two prototypes were ordered.

The XA-44/XB-53 was a most interesting design, probably the first in the United States to incorporate the swept forward wings originated in wartime Germany. These wings, with a sweep of 30 degrees and 8 degrees of dihedral, were to be mounted on the rear fuselage. A fin and rudder only comprised the tail unit. Three General Electric J35 turbojets were carried inside the broad fuselage, an air intake being positioned each side of the fuselage. In attack configuration the aircraft carried a crew of two and the fuselage nose was solid. Armament was expected to comprise no less than 20 0.50in guns, and maximum speed and range were estimated at 938km/h (583mph) and 3540km (2200 miles) respectively. As a bomber a crew of four would have been accommodated and armament would have included 12 1000lb bombs and 40 5in rockets in the bay and under the wings.

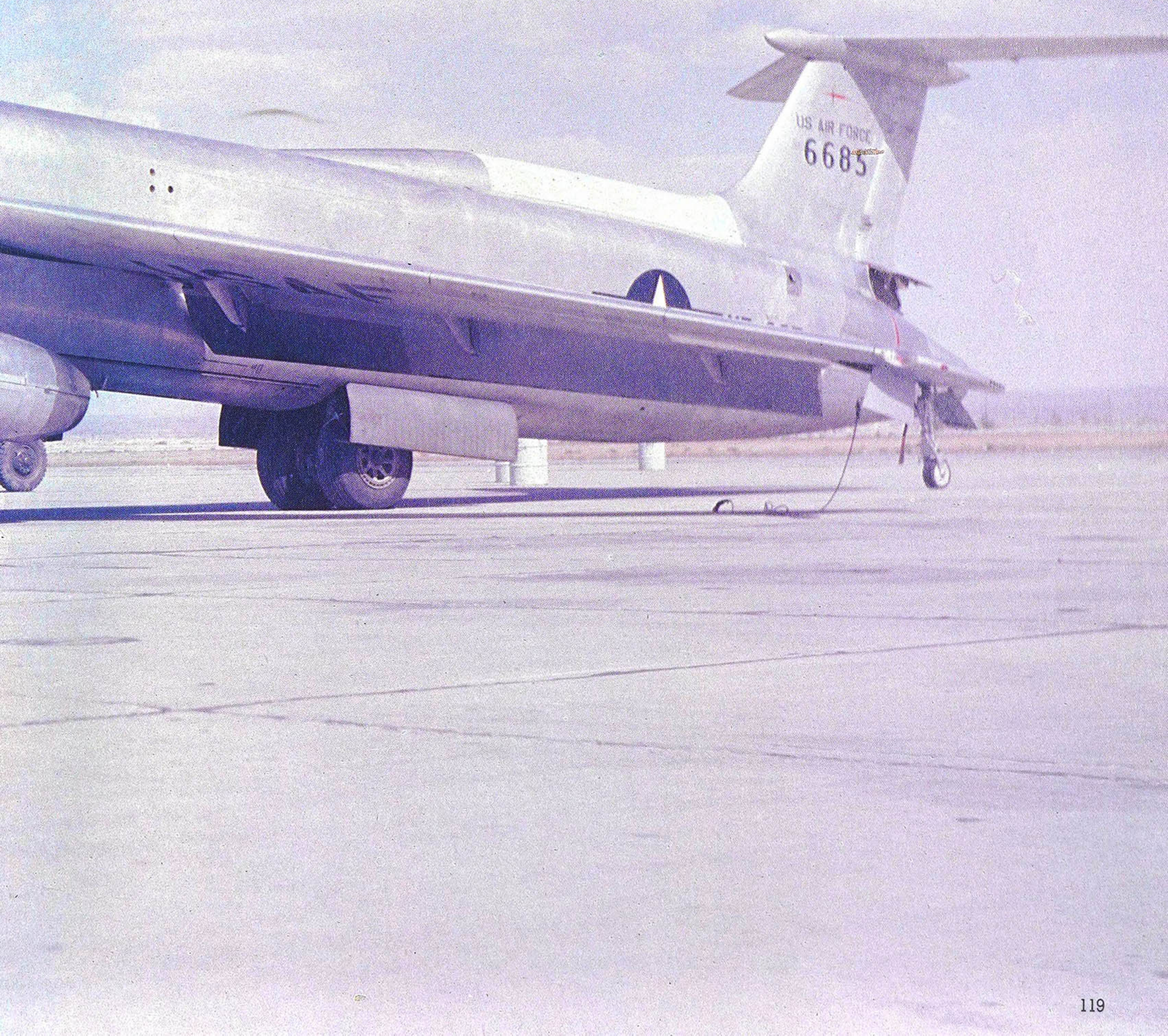
Previous page: RAF SEPECAT Jaguar GR.Mk 1s sweep out to sea at low level.

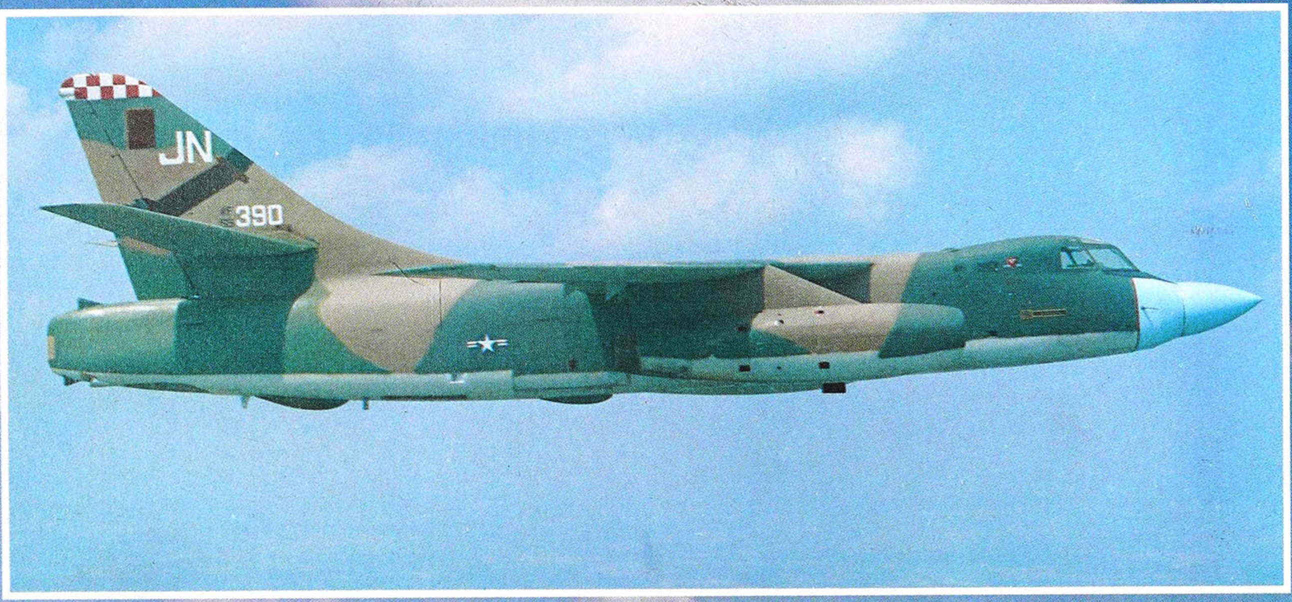
Martin XB-51 three-jet attack bomber.



Artist's impression of the projected Convair XB-53, drawn from Convair Division material.

The A-45, actually the last aircraft to carry the original 'A' series designation, came from Martin but was subsequently redesignated XB-51. Two prototypes again were ordered, the first of which flew initially on 28 October 1949. Power was provided by three General Electric J47 turbojets, two in pods carried on the lower forward sides of the fuselage and one in the rear fuselage. The mid-mounted wings were swept back at 35 degrees and a 'T' tail was used. The crew comprised a pilot under a fighter-type





Above: WB-66D Destroyer, equipped to collect meteorological information over a battle area.

Douglas RB-66C version of the Destroyer, with underfuselage and underwing radomes, first flown on 29 October 1955.

EB-66B Destroyer, used in Vietnam as electronic countermeasures aircraft.

canopy and a navigator in a cabin to the rear.

By the time the two prototypes had been handed over to the USAF for testing, the United States was at war in Korea. Now the USAF urgently required new light attack bombers and found them in the form of the Canberra and B-66 Destroyer. As neither were new designs they offered a quick and safe way out. As for the XB-51, this was abandoned.

The Canberra, which became the B-57 when produced in the United States by Martin, has already been mentioned. The Destroyer was basically a derivative of the Navy's Skywarrior and yet actually managed to beat it into service. The initial version was the RB-66A, five of which were produced as four-camera trial tactical reconnaissance aircraft. Each was powered by two Allison J71-A-9 turbojet engines carried in underwing pods. The first flew initially on 28 June 1954, marking the first flight of a Destroyer.

The bomber version of the Destroyer was the B-66B, 72 being completed. The first was flown on 4 January 1955. The Allison J71-A-11 engines of the early examples were superseded by 4627kg (10,200lb)st J71-A-13s. Armament comprised conventional and nuclear weapons carried in the bay and two 20mm cannon carried in a tail ball-turret and remotely controlled by one of the three crew. Maximum speed was 1013km/h (630mph). Those entered service from 10 March 1956.

The major production version of the Destroyer was the RB-66B, basically an RB-66A but carrying five cameras, photoflash bombs and cartridges. B-66B engines and tail armament were fitted. The first of the 145 built was delivered to the USAF on 1 February 1956, making this the first production version to enter service. A further 36 Destroyers were built as RB-66C all-weather electronic reconnaissance aircraft and a similar number of WB-66Ds were produced. The WB-66D was the first weather reconnaissance aircraft to be built as new. During the conflict in Vietnam a small number of B-66Bs were converted into EB-66B ECM aircraft and some RB-66Cs became EB-66Cs with ECM. These were the final Destroyers in USAF operational service.

Today in many air forces, the attack aircraft is represented by some of the most up-to-date combat planes. These not only serve worldwide but have been or are being manufactured in many different countries, a far cry from the old days. However, not included here are the fighter-bombers fully covered in *Jet Fighters*. Only brief mention of each type is given as these are

EMBRAER EMB-326GB/AT-26 Xavante light attack/trainer built in Brazil.

British Strikemaster Mk 82 in service with the Sultan of Oman's Air Force, armed with bombs and rockets.


XX947
XX947

IDS Tornado in service with the German Air Force and seen here at the weapon conversion unit at Erding.

Left: An early Panavia Tornado flying fast and low through mountain valleys carrying eight 1,000lb bombs, electronic countermeasures pods and auxiliary fuel tanks.

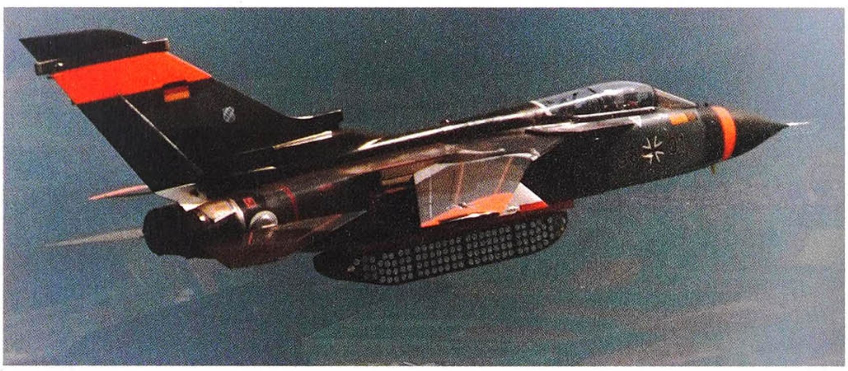
not jet bombers in the traditionally accepted sense.

From Argentina comes the twin turboprop-engined FMA Pucará, a lightweight close support and counterinsurgency aircraft with the ability to carry up to 1686kg (3717lb) of weapons in addition to its two fixed cannon. Maximum speed at an all-up weight of 5500kg (12,125lb) is 500km/h (310mph). From its South American neighbor Brazil comes the EMBRAER AT-26 Xavante, just one license-built version of the Italian Aermacchi MB326 jet trainer and ground attack aircraft. The MB326/AT-26 is a typical example of many dual purpose aircraft in this category, another being the British BAe Strikemaster that was exported to 10 countries.

Europe is represented by four types. One is the two-seat Panavia Tornado Mach 2+ multipurpose combat aircraft, now becoming operational in Britain, West Germany and Italy as those countries' first swing-wing aircraft. Capable of many roles including close air support, interdiction and naval strike, it can carry up to 9072kg (20,000lb) of weapons.

The other three European aircraft are the Mach 1.6 SEPECAT Jaguar tactical support aircraft, built by France and Britain and exported and capable of carrying up to 4763kg (10,500lb) of weapons; the broadly

Tornado armed with an underfuselage munitions dispenser.



Below: An IDS Tornado (interdictor strike version) refuels another Tornado using a buddy-buddy refueling system.

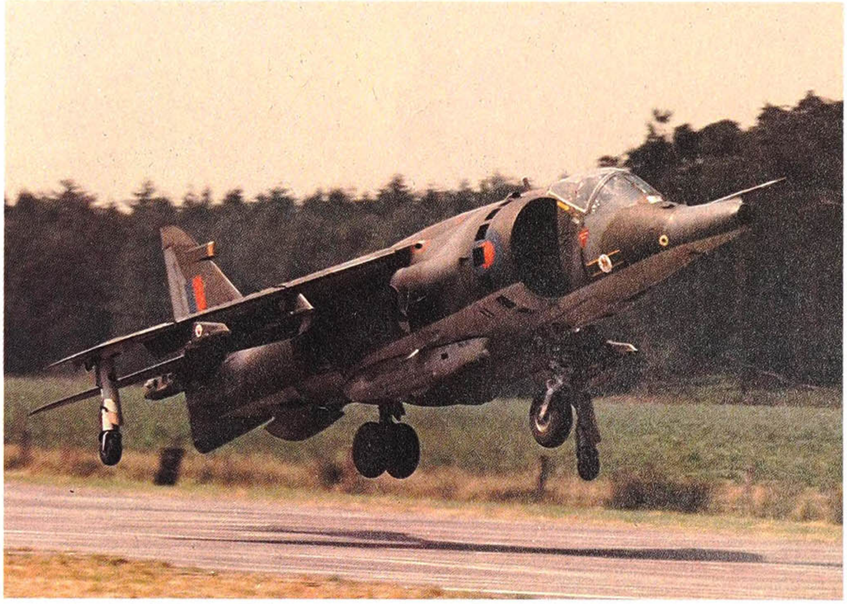

A 125

French air force Jaguar A, flown by the 11th Escadre de Chasse.

Jaguar International for Oman, the export version of the Jaguar with the most powerful engines to enhance performance and maneuverability.

RAF Jaguar T.Mk 2 two-seat operational trainer carrying four 1,000lb bombs during rough field take-off trials.

The combat-proven British Aerospace Harrier GR.Mk 3 lifts off.



similar 1160km/h (721mph) Romanian/ Yugoslav SOKO/CNIAR Orao/IAR-93 close support aircraft, powered by Rolls-Royce Viper engines; and the BAe Harrier V/STOL close support aircraft capable of carrying more than 2270kg (5000lb) of stores. The US-developed AV-8B Harrier II derivative for the USMC and RAF has greater performance and a heavier weapon load and is scheduled for service from late 1983.

Soviet aircraft in this category are represented by several types from Mikoyan and Sukhoi. The Mach 1.5 Mikoyan MiG-27 (NATO *Flogger*) is a single-seat swing-wing ground attack aircraft derived from the MiG-23 fighter. The new Sukhoi Su-25 (NATO *Frogfoot*) single-seat close support aircraft has a similar role to the USAF's A-10A but has its engines carried in the wing-roots. The maximum weapon load of the

Right: US-developed AV-8B Harrier II in USMC markings and carrying bombs and air-to-air missiles.

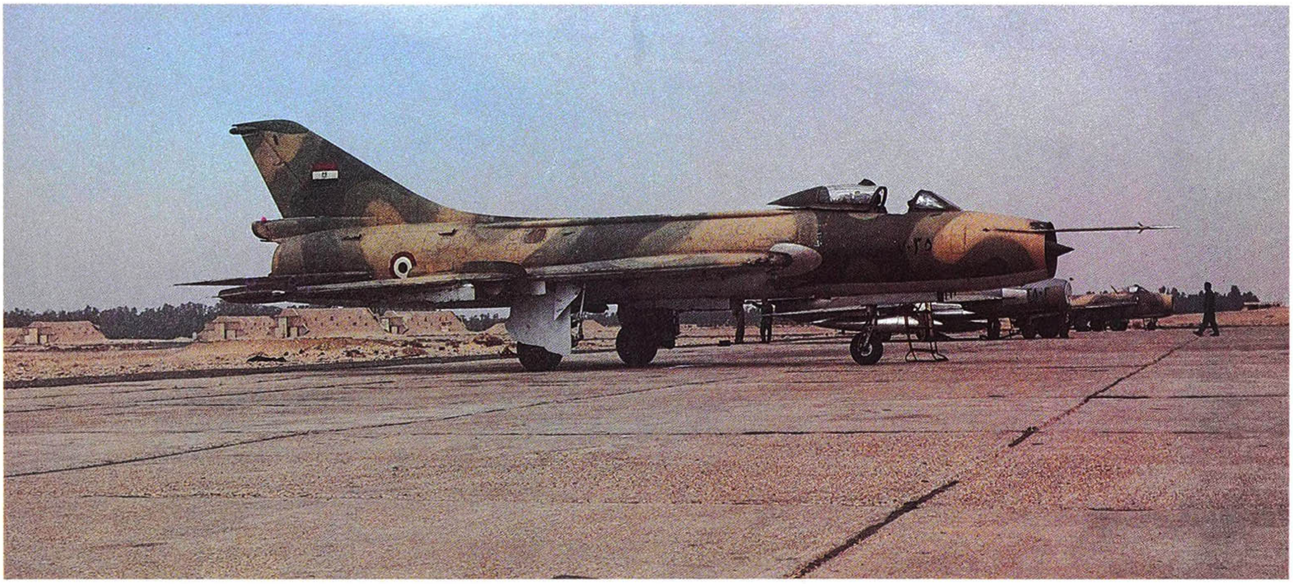
Below: As the attacks on Port Stanley airfield and Goose Green on 1 May 1982 proved, the Sea Harrier is more than just a naval fighter and reconnaissance V/STOL aircraft.

Right: Polish Air Force Sukhoi Su-7B with its twin brake-chute deployed.

Su-25, which became operational in 1983, is unknown: that for the MiG-27 is 3000kg (6615lb).

The single-seat Mach 1.6 Sukhoi Su-7B (NATO *Fitter-A*), which dates from the 1950s, is still in use in many countries, as are the much newer Mach 2+ Su-17/20/22 (NATO *Fitter*) swing-wing attack aircraft built for the Soviet forces and for export.

Below: Egyptian Air Force Sukhoi Su-7BM, one of forty in operational use.



The most powerful Soviet attack aircraft is the Su-24 (NATO *Fencer*), also using swing-wings and accommodating a crew of two seated side-by-side. Maximum speed and weapon load are Mach 2+ and approximately 8000kg (17,635lb) respectively.

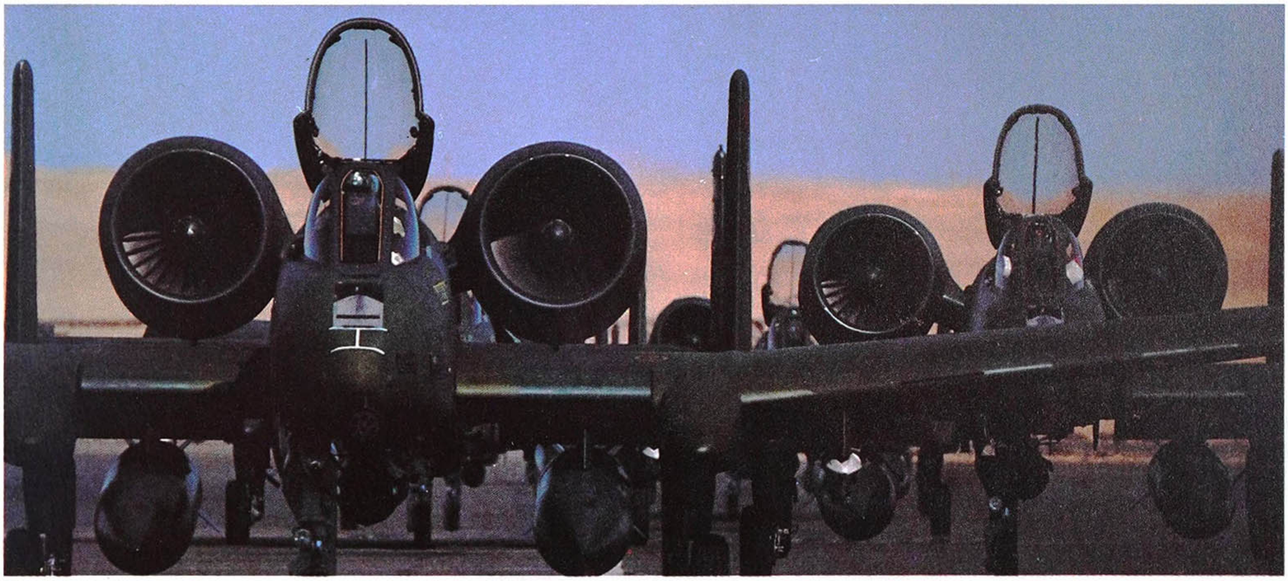
The United States has several aircraft that fit into this category, despite the General Dynamics F-111 not being included as this tactical fighter is covered in *Jet Fighters*. Currently the most prominent is the Fairchild Republic A-10A Thunderbolt II, which became operational in 1977 as a close support aircraft capable of 706km/h (439mph) without externally-carried weapons. Armament comprises a General Electric GAU-8/A Avenger 30mm seven-barrel cannon in the nose and up to 7250kg (16,000lb) of ex-

Left: Far more formidable than the Su-7B is the Su-20, one of two export versions of the Soviet Su-17 *Fitter*.

Right: One of 586 Fairchild Republic A-10A Thunderbolt II close support aircraft delivered to the USAF by the beginning of 1982.

Below: A Maverick air-to-surface missile about to be loaded on an A-10A.

Bottom: A-10As of the 353rd Tactical Fighter Squadron, USAF, prepare to attack during the US/Egyptian exercise Bright Star 82.



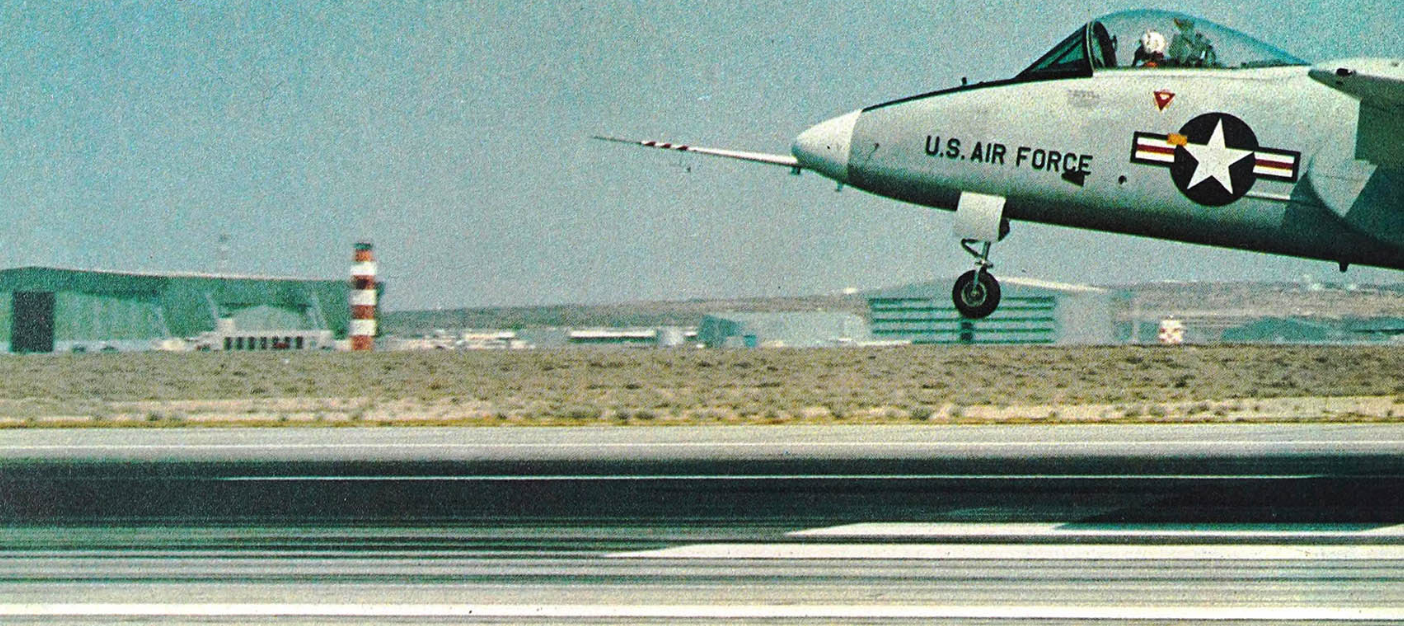
The USMC's two-seat Rockwell International OV-10D, 17 of which were produced as night observation and surveillance aircraft from OV-10As Armament capability is retained.

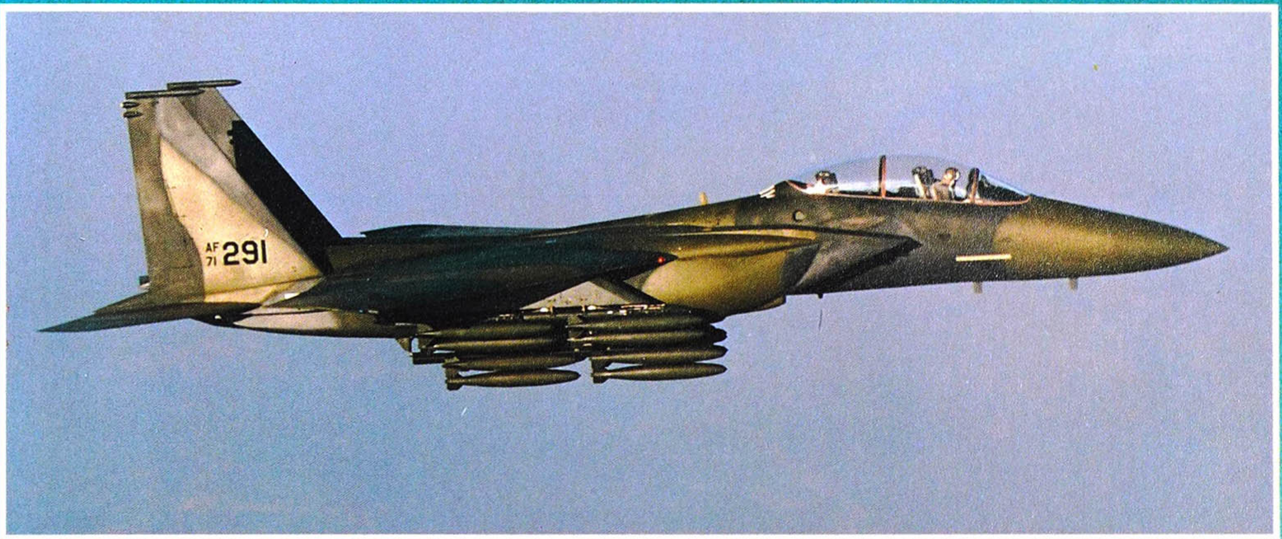
ternal stores. This aircraft, which was selected for service in preference to the Northrop A-9A, is powered by two rear fuselage-mounted turbofan engines.

The Rockwell International OV-10 Bronco is a two-seat lightweight multipurpose counter-insurgency aircraft used by the USMC and exported. It is powered by two turboprop engines, has a maximum speed of 463km/h (288mph) and can carry 1633kg (3600lb) of weapons on fuselage attachment points.

Three US aircraft of fighter configuration but designed for interdiction/strike roles are the McDonnell Douglas F-15E Enhanced Eagle, the General Dynamics F-16XL and the Northrop F/A-18L. The former, based on the USAF's Eagle air superiority fighter, will carry a weapon load of 10,885kg (24,000lb). The F-16XL is an advanced technology version of the Fighting Falcon and

Northrop's rival to the A-10A was the A-9A, but this was not ordered into production. Reports suggest that the Soviet *Frogfoot* could be similar.





Formerly known as Strike Eagle, the F-15E Enhanced Eagle will be capable of day, night and all-weather attacks.

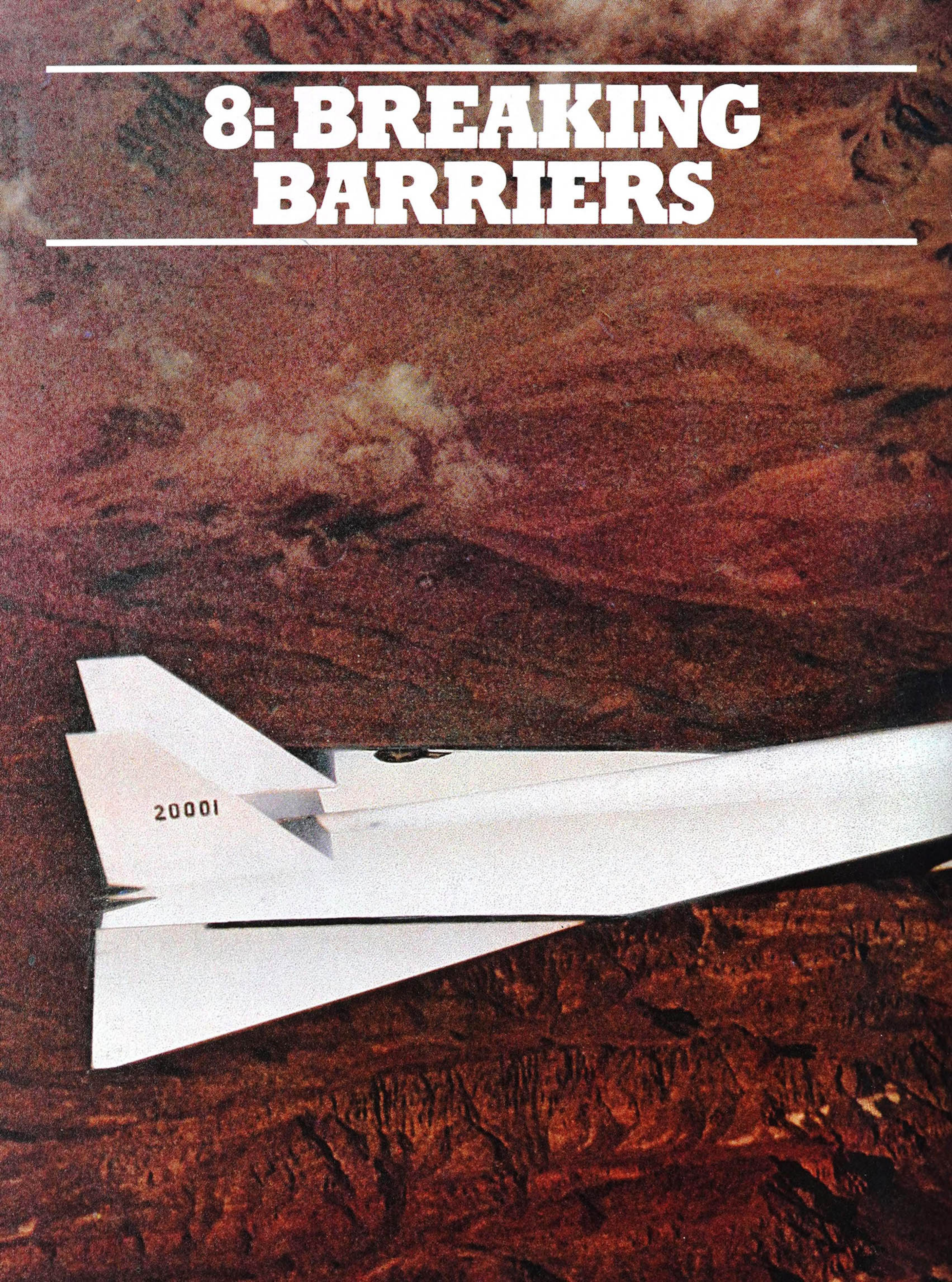
will carry up to 6803kg (15,000lb) of stores. The F/A-18L, based on the US Navy Hornet, can carry a load weighing 9072kg (20,000lb). All are also capable of fighter roles, but none as yet is in service.

The last aircraft to be mentioned comes from China and was also covered in *Jet Fighters*. Known in that country as the Qiangjiji-5, to others as the Nanchang Q-5 and to NATO as *Fantan-A*, it is a Mach 1.35 fighter-bomber also used for air defense. It is mentioned in this book as its Chinese name means Attack aircraft 5. It is, with the F-111 from the USA, one of a very small number of non-strategic aircraft with an internal weapons bay for conventional or nuclear bombs. Other weapons can be carried underwing. Q-5s currently serve with the Air Force of the People's Liberation Army and with the Pakistan Air Force.

Four Nanchang Q-5 *Fantan-A*s strike out across mountainous terrain during low-level flying training.

The rear cockpit of the F-15E is occupied by a specialist officer, who operates targeting avionics.

8: BREAKING BARRIERS




U.S. AIR FORCE

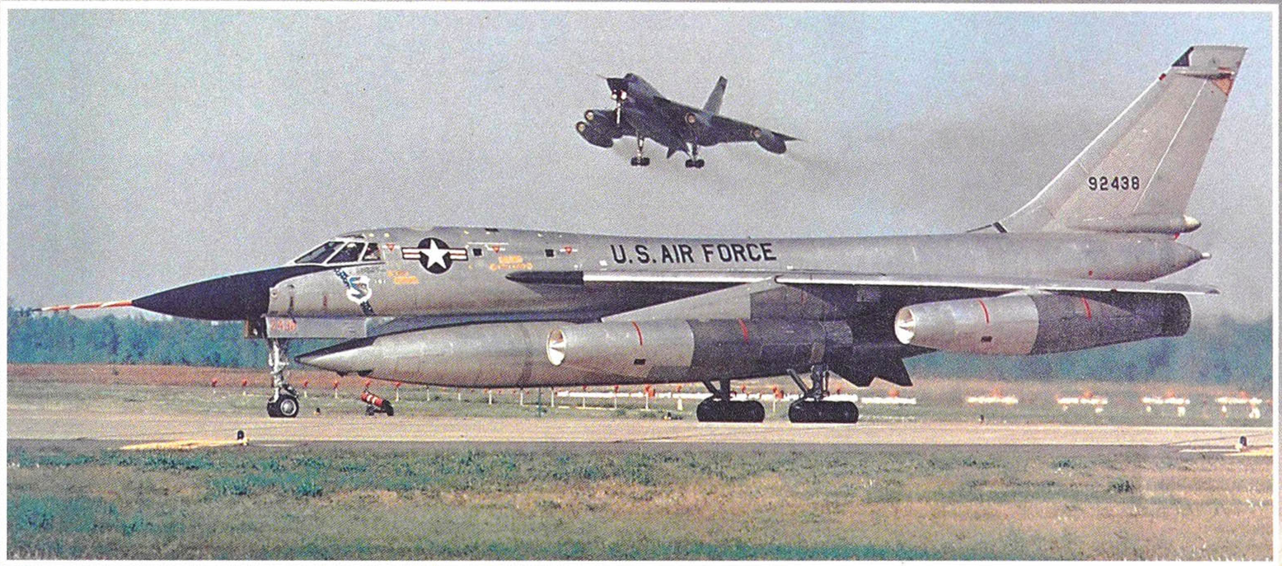
The 1940s were not over before attention was turned in the United States to the possibility of producing a jet bomber with supersonic performance. The leap from the existing subsonic jet bomber types to an aircraft with supersonic performance took several more years but the resulting aircraft was not merely a Mach 1 but a Mach 2 bomber.

In 1948 Convair had flown its Model 7002 (XF-92A) as the world's first true delta-winged aircraft. This wing configuration became a standard feature of Convair aircraft for a long period thereafter, but one of its first applications was for a proposed supersonic bomber. This won a USAF design study competition of 1949. Two years later the project was assigned the designation XB-58 by the USAF, together with a contract to continue design of the 'generalized' bomber.

By then Boeing too had entered the competition to provide the USAF with its first supersonic bomber. From April 1951 the company produced many designs under its model 701 type number and actually re-

This view of the B-58A Hustler shows clearly the bomber's delta wings, engine layout and the single compartment fuel/ weapon pod carried under the fuselage.

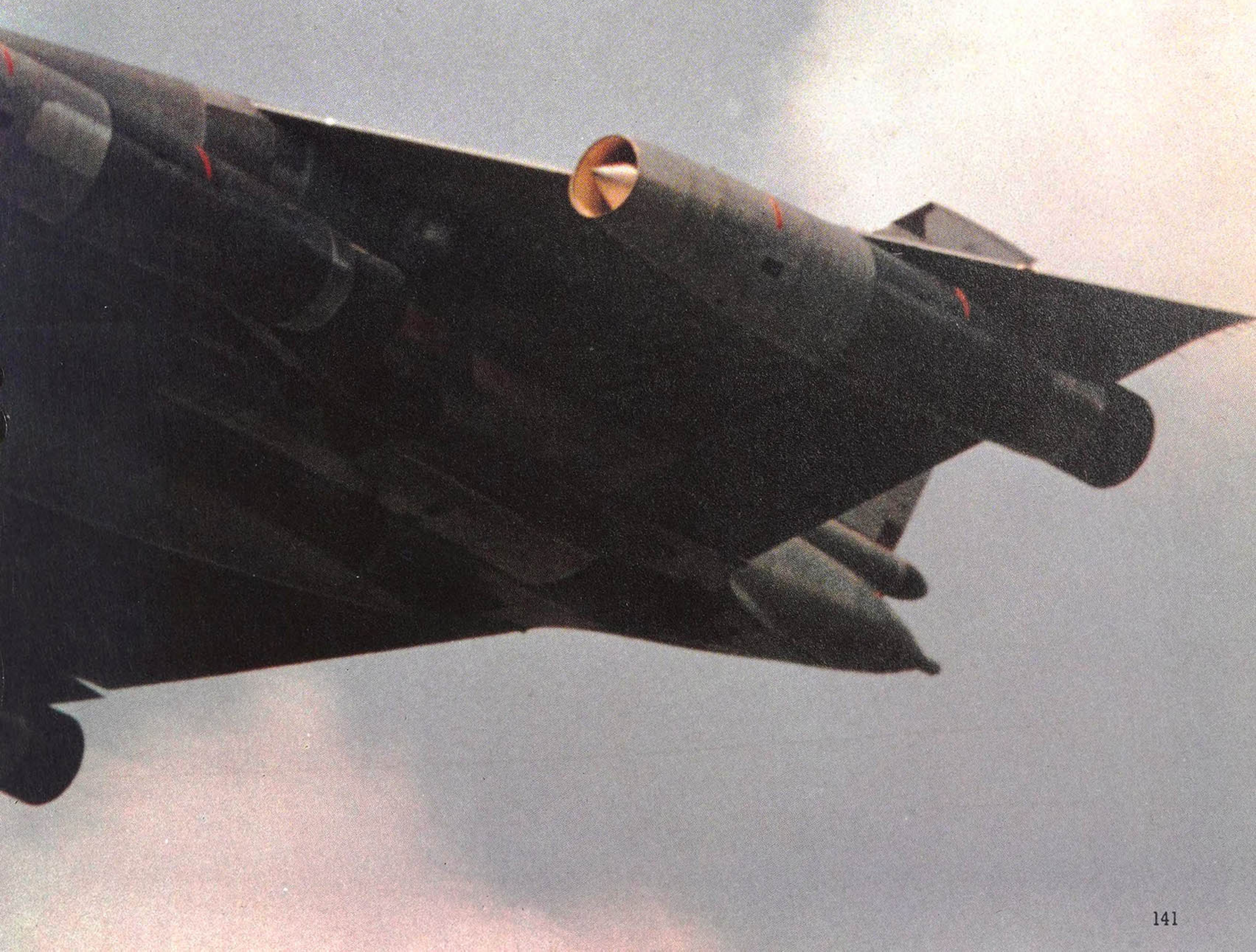
Previous page: North American Valkyrie during low-altitude supersonic cruise flight, with wingtips folded at 25 degrees.



ceived the official USAF designation XB-59 for its project. However, no prototype was ever built by Boeing, although progressive configurations included those with swept-back and delta wings.

In August 1952 Convair received the MX-1964 contract to produce the B-58 under the new weapon system management concept, making Convair responsible for managing the development of all B-58 systems with the

The Convair B-58A Hustler was the world's first production supersonic bomber, entering USAF service in 1959 and becoming operational the following year.



The General Dynamics FB-111A was developed from the F-111 tactical fighter. As this photograph shows, the F-111 itself can carry a heavy bombload.


MO
AF 70 366

An early FB-111A/SRAM attack missile combination.

exception of the turbojet engines. The first of two XB-58 prototypes flew for the first time on 11 November 1956. These were followed by a second prototype, 11 further service test YB-58As and another 17 test aircraft (ordered in early 1957) including some in reconnaissance bomber configuration.

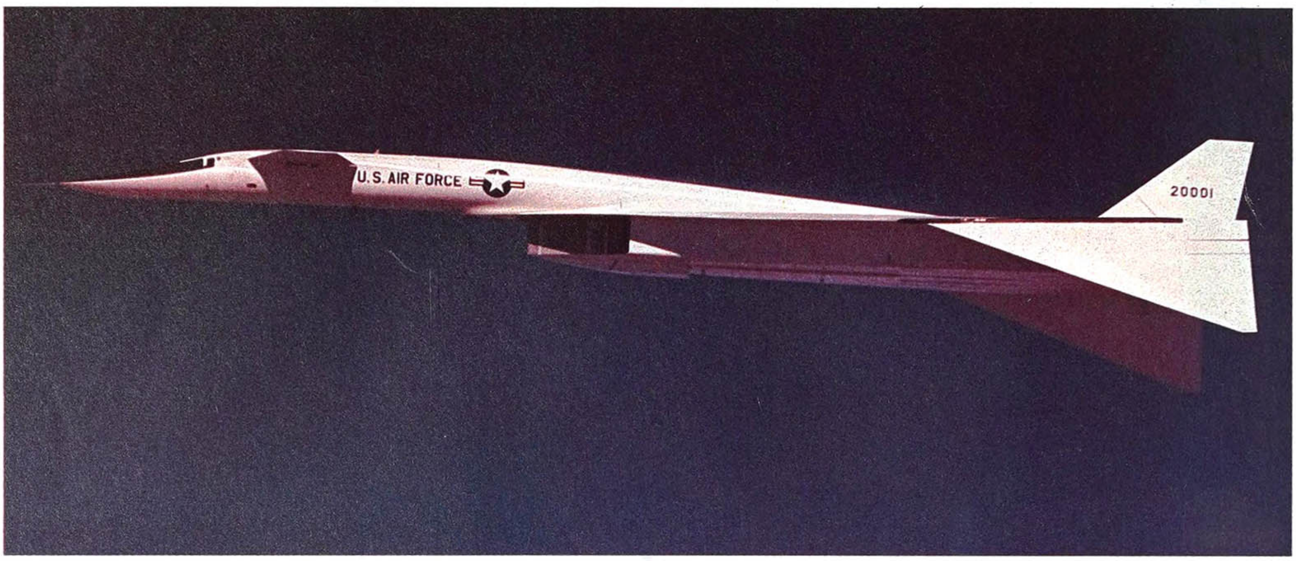
The B-58 itself had mid-mounted delta wings. Because of the high temperatures associated with Mach 2 flight, the heat and fatigue-resistant skin panels used on the wings and fuselage were constructed as a sandwich, with glassfiber/aluminum/stainless steel honeycomb between layers of metal. The bomber also made the first use of the escape capsule concept, in which the crew of three sat in individual capsules that could be ejected in an emergency, thereby allowing ejection at supersonic speed. The first manned ejection took place in February 1962 and B-58s delivered without this system were subsequently modified. Armament comprised a radar-directed Vulcan 20mm multibarrel tail cannon and nuclear or conventional bombs carried inside a jettisonable underfuselage pod. The pod also carried the fuel for the outward journey. Subsequently a two-compartment pod was developed, the lower fuel-carrying section being jettisoned when empty and the upper carrying fuel, a bomb and electronic equipment. Fuel for the home journey was carried in wing tanks. Maximum take-off weight of the B-58A production aircraft was 73,935kg (163,000lb), maximum speed 2229km/h (1385mph) and range 3862km (2400 miles).

The first eight of the 86 production B-58s built were each powered by four General Electric J79-GE-1 turbojets. The standard engines thereafter were four 7076kg (15,600lb)st with afterburning J79-GR-5 series turbojets. In addition, 10 service test aircraft were brought up to production standard for service in the bomber role and

Below: General Dynamics proposed the conversion of F-111Ds and FB-111As into FB-111B/C penetration bombers, with new engines and greater wing span. This remained a project.

The underside of a camouflaged FB-111A with SRAM. The angle of wingsweep varies according to the type and number of weapons attached to external pylons.

FB-111A carrying four SRAM under the wings and two in the fuselage bay approaches a flight refueling tanker.



Valkyrie during high-altitude and high-speed cruising flight, with wingtips folded at 65 degrees.

eight became TB-58A dual-control trainers.

The B-58A, known as the Hustler, was delivered to the USAF's 43rd Bombardment Wing stationed at Carswell AFB, Texas, from late 1959, becoming operational in March of the following year. By August three squadrons were operational. The 305th Wing received Hustlers in 1961. The bomber remained operational throughout the 1960s.

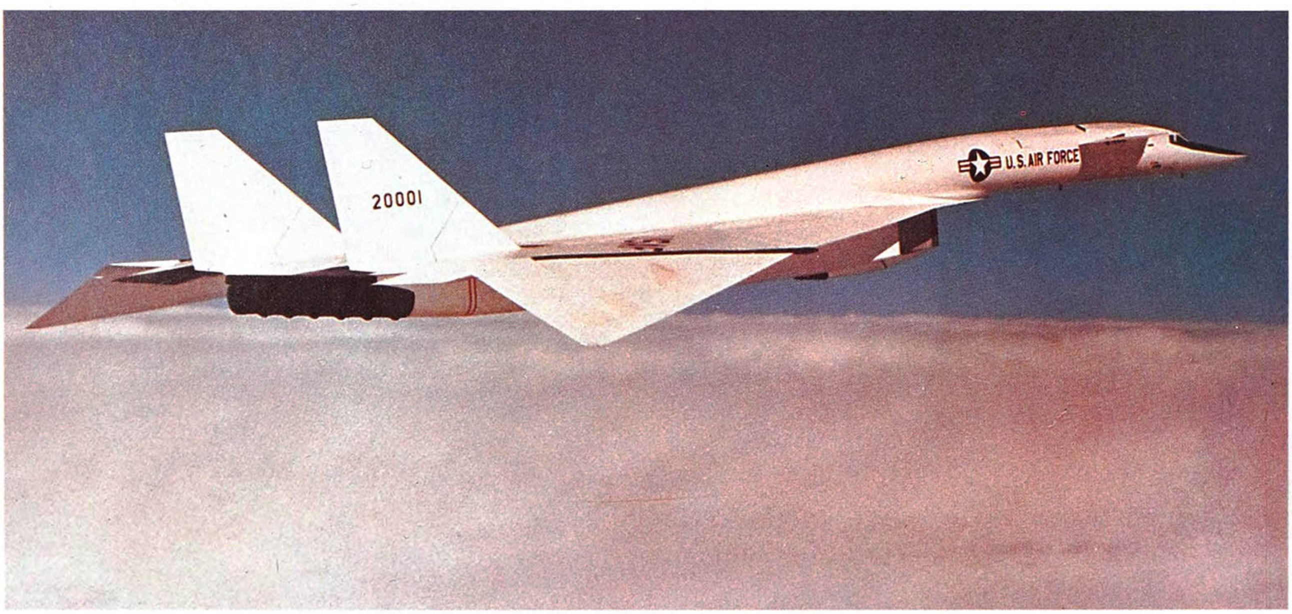
This view of Valkyrie shows clearly the layout of the six turbojet engines and the rectangular-section air duct forward.

It was to Carswell AFB that the General Dynamics FB-111A two-seat strategic bomber was first delivered in October 1969, to equip the 340th Bomb Group. This Group provided training for the operational Wings.

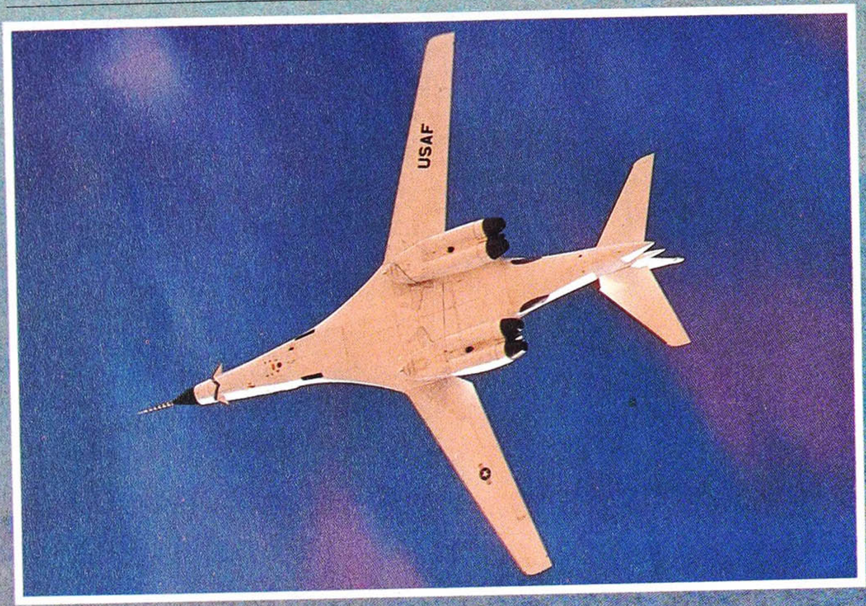
The FB-111A was a strategic bomber development of the F-111 swing-wing tactical fighter, developed to supersede both the early versions of the Boeing B-52 Stratofortress and the Hustler. Of the 253 planned for service, only 76 were in fact completed. The first of these flew initially on 13 July 1968 and all had been built by 1971. A larger and more powerful derivative known as the FB-111H and also FB-111B/C conversions were also considered when the B-1 bomber was cancelled, but these were never built.

Right: Roll-out of the first Rockwell International B-1 strategic bomber prototype at Palmdale, California, on 26 October 1974.

The FB-111A accommodates a crew of two side-by-side and is powered by two 9230kg (20,350lb)st Pratt & Whitney TF30-P-7 with afterburning turbofan engines. The 60 aircraft that currently equip five medium-range bomber squadrons of Strategic Air Command (three aircraft are also in reserve) can each carry six SRAM missiles, four underwing and two in the internal weapons bay, or up to 14,288kg (31,500lb) of conventional weapons. Maximum speed is Mach 2.5 and range 6598km (4100 miles) while carrying external fuel tanks.



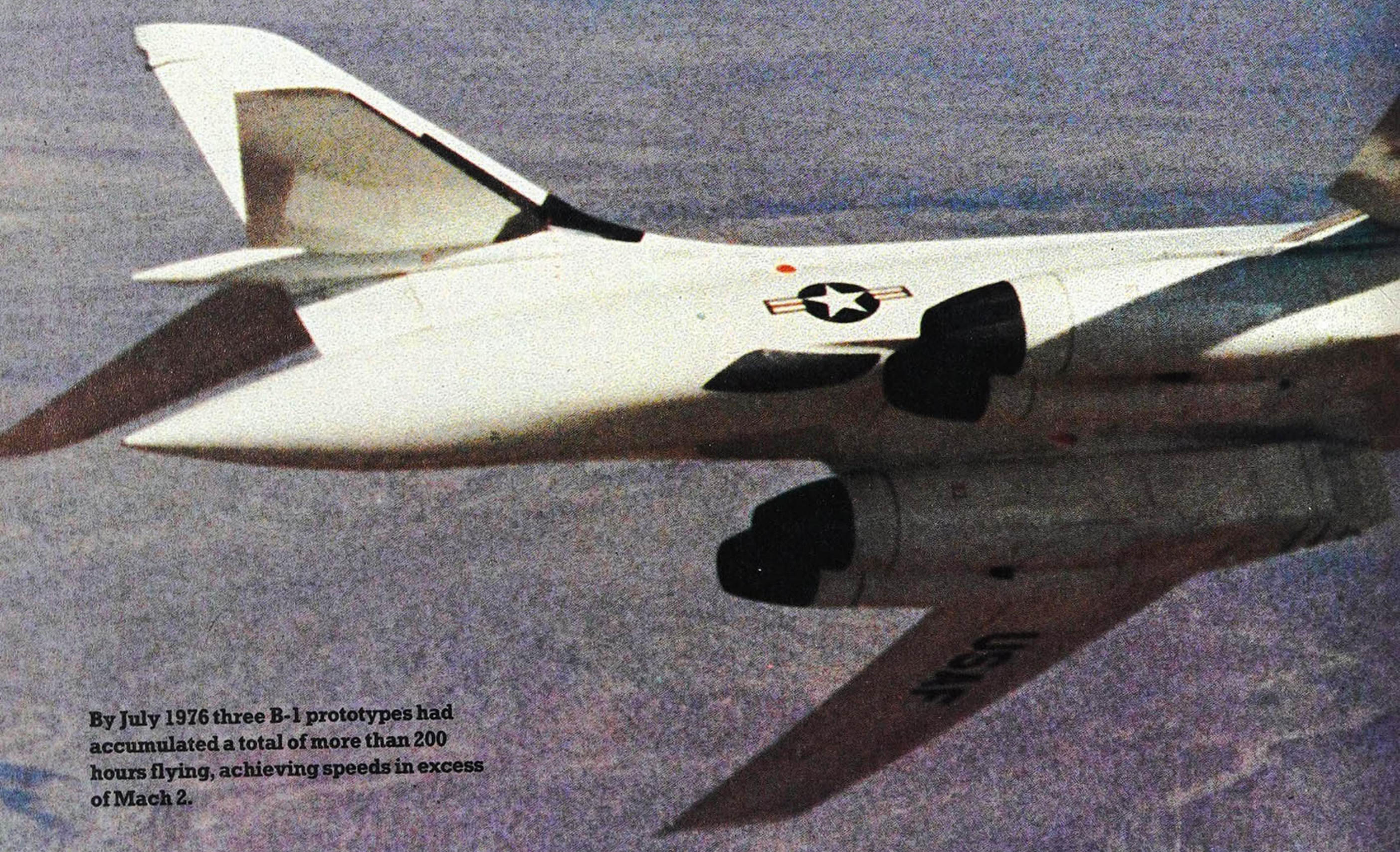

USAF



The first B-1 prototype on its second flight.

The first full-range strategic bomber developed as a B-52 replacement was the incredible North American XB-70 Valkyrie. A huge delta-winged aircraft with 12 elevons and fold-down wingtips for high-speed cruise, large foreplanes and powered by six 14,060kg (31,000lb)st General Electric YJ93-GE-3 turbojet engines, it could cruise to and from the target at a constant Mach 3. Unrefueled range was approximately 12,230km (7600 miles). First flown on 21 September 1964, the bomber was cancelled before production.

The second supersonic B-52 full-range replacement was produced by Rockwell International as the Mach 2+ B-1 low-altitude

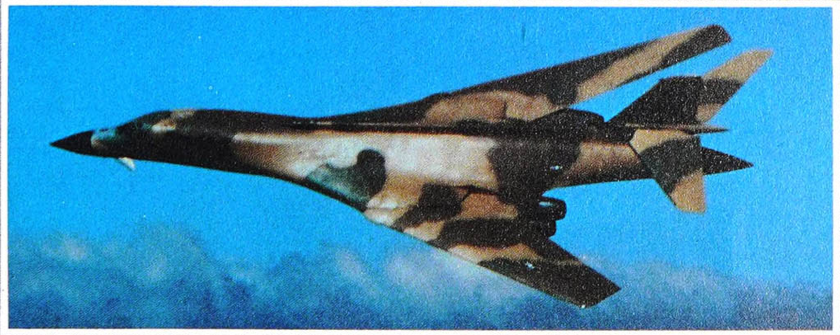


By July 1976 three B-1 prototypes had accumulated a total of more than 200 hours flying, achieving speeds in excess of Mach 2.

B-1 prototype with wings fully spread.

penetration bomber. The first swing-wing prototype flew for the first time on 23 December 1974. Two hundred and forty-four were to have been delivered to SAC by 1981, but production was cancelled by President Carter in 1977 after four prototypes had been completed.

President Carter's cancellation of the B-1 in favor of cruise missile development led to proposals for a cruise missile carrier, one obvious answer being a B-1 derivative. However, the Air Force Scientific Advisory Board suggested that a new USAF strategic bomber should be capable of other bombing roles in addition to carrying cruise missiles and in 1981 President Reagan announced that the USAF would receive 100



B-1 prototype in camouflage, with wings swept.

derivative Rockwell International B-1Bs from 1985 to 1988.

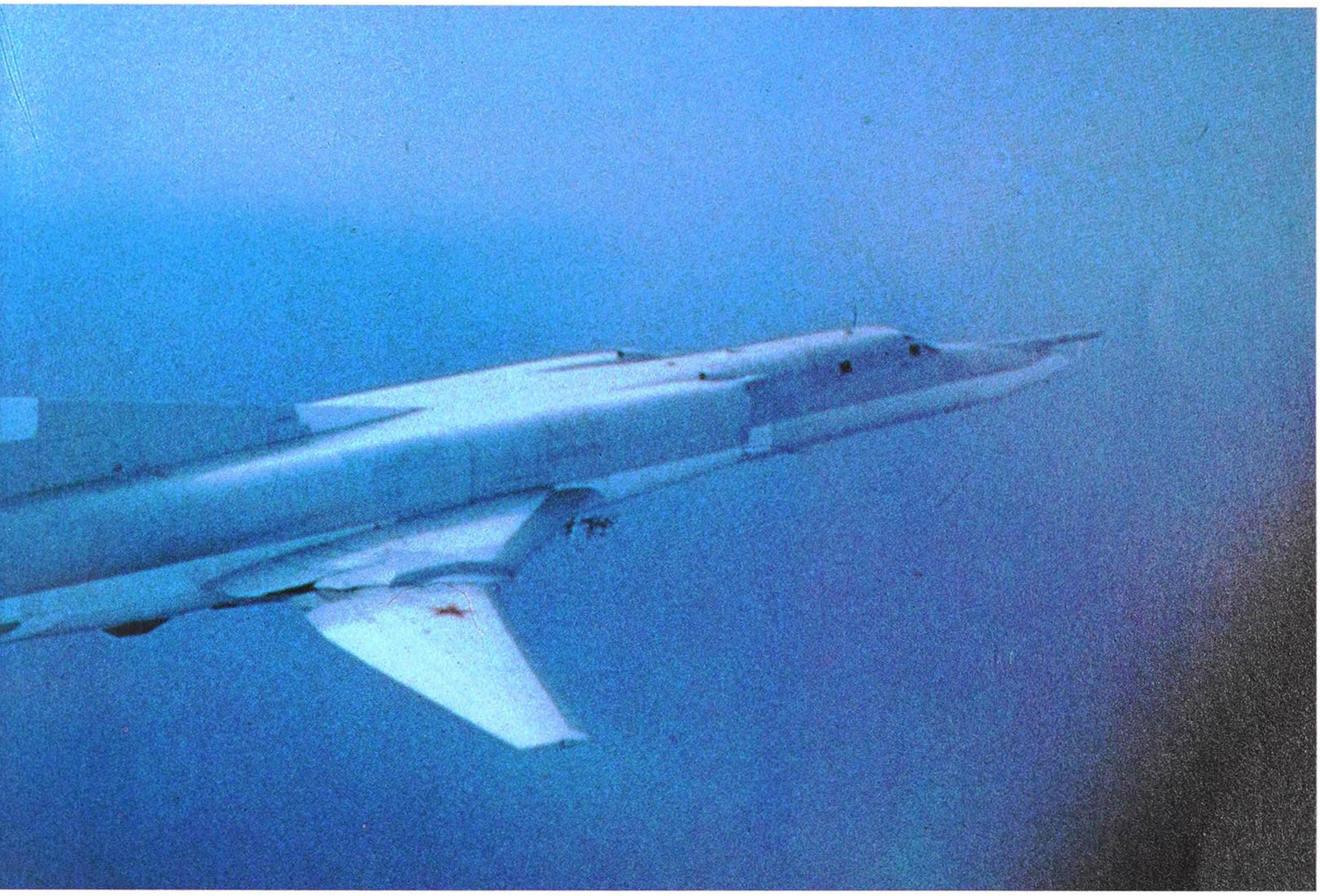
The B-1B is also a swing-wing aircraft, but has a designed maximum speed of Mach 1.25. Power is provided by four 13,608kg (30,000lb)st General Electric F101-GE-102 augmented turbofan engines carried in pairs below the wing center-section. This 12,000km (7455 mile) unrefueled-range bomber will be capable of carrying eight ALCM or 24 SRAM missiles, or nuclear or conventional bombs internally, and similar weapons on external underfuselage attachments. When carrying conventional 500lb Mk 82 bombs only, 128 can be carried internally and externally.

Soviet supersonic bomber capability was introduced with the Tupolev Tu-22, known to NATO as *Blinder*. First seen in public during the Aviation Day celebration of 1961, it has mid-mounted swept wings and is powered by two turbojet engines positioned above the rear fuselage each side of the vertical tail. As with the US Hustler, to which it could be compared, *Blinder* carries a crew of three in tandem cockpits. However, *Blinder* has a maximum speed and unrefuelled radius of action of approximately Mach 1.4 and 3100km (1925 miles) respectively.

It is believed that approximately 250 Tu-22s were built in several versions. The *Blinder-A* reconnaissance-bomber carries bombs in the weapons bay. *Blinder-B* is capable of carrying the *Kitchen* nuclear air-to-surface strategic missile and *Blinder-C* was deployed as a maritime reconnaissance aircraft but now has likely electronic intelligence or ECM capabilities. *Blinder-D* is a tandem cockpit trainer. The Soviet long-range air force currently operates approximately 125 *Blinder As* and *Bs* as bombers and 15 *Blinder-Cs* for reconnaissance. Naval Aviation currently deploys approximately 40 *Blinder-As* and a handful of *Blinder-Cs*. Bombers are also operational with Iraq (9) and Libya (7), and the Soviet Union and Libya use *Blinder-D.*

Undoubtedly the most important strategic bomber to enter service in the past decade has been the Soviet Tupolev Tu-22M, its designation indicating that it was intended as a *Blinder* replacement. However, there are no similarities between the two types in terms of configuration or performance, although *Backfire* (NATO name) has

The B-1B will incorporate very advanced avionics. Technological advances will reduce its radar signature to just one percent of that of the USAF's current Stratofortress.



Tupolev Tu-22M *Backfire-B* photographed by a Swedish Air Force pilot.

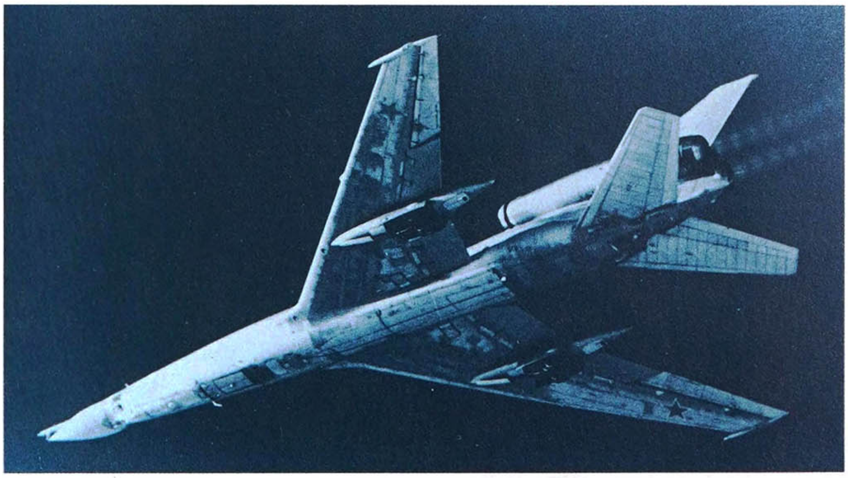
two turbofan engines mounted side by side in the rear fuselage.

First flown in prototype form in 1971, the Soviet strategic long-range air force operates approximately 100 *Backfire-A*s and improved *Backfire-B*s as strategic bombers. Naval Aviation currently has about 80 for attack and maritime reconnaissance roles. *Backfire* continues in production. These bombers operate in the European area and over the Atlantic, but can also reach the United States with flight refueling. An advanced version of *Backfire* has also been flown.

Backfire is in the mold of the latest bombers, having swing wings. It has a maximum take-off weight of approximately 122,500kg (270,000lb) and a maximum speed of Mach 2. Its armament can comprise twin radar-directed 23mm cannon in a tail position and up to 12,000kg (26,450lb) of bombs or a *Kitchen* missile. A decoy missile of the US Quail type may have been developed for Soviet bombers. *Backfire* can fly to a target approximately 5470km (3400 miles) from base without flight refueling.

The latest Soviet bomber is also from the Tupolev design bureau and is known to NATO as *Blackjack*. This is said to be a manned swing-wing penetration bomber nearly half as big again as *Backfire* and larger than the USAF's future B-1B. It is capable of a maximum speed of Mach 2.3 and has an unrefueled range of 13,500km (8400 miles). Armament may include cruise missiles or other nuclear or conventional weapons up to approximately 16,330kg (36,000lb). *Blackjack* could be operational by 1986.

Two Soviet supersonic bombers that failed to reach production were the



***Blinder* twin-turbojet supersonic bomber in high-speed flight.**

The TSR 2 was capable of fully automatic attacks from high or low level.

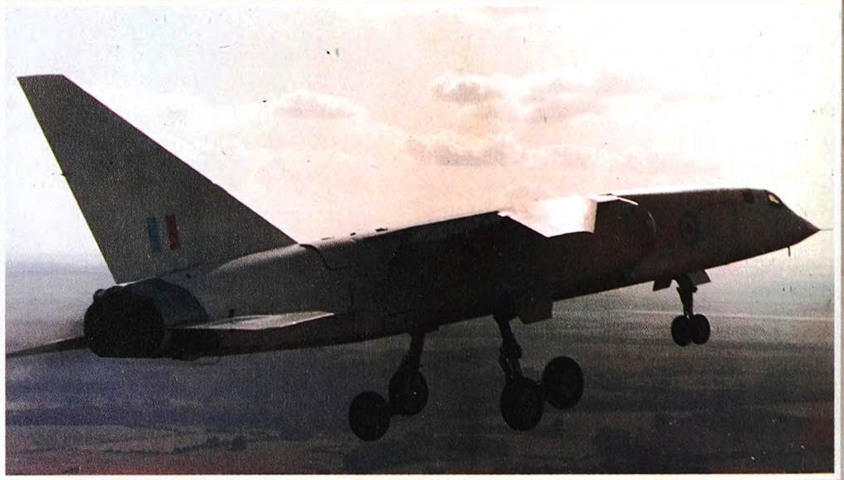
Myasishchev M-52 (NATO *Bounder*) of 1958, a 2000km/h (1243mph) strategic bomber of limited range, and the four-engined supersonic cruise bomber built in the 1970s by Sukhoi. The latter had the look and probably the speed of the US XB-70.

A British supersonic attack bomber and reconnaissance aircraft that could have become operational in the 1960s was the BAC TSR 2. At the time of its first flight in September 1964 this was probably the most formidable aircraft of its type in the world. A two-seater, it had a speed of Mach 2.05-2.5 and a range with underwing tanks of about 2780km (1727 miles). Its avionics would have allowed completely automatic high and low level attacks without visual reference.

France joined the USA and USSR in having its own supersonic strategic bomber during the 1960s, with the delivery from 1963 of 62 production delta-winged Dassault Mirage IV-As. Based on an enlarged Mirage III configuration, the prototype first flew on 17 June 1959. Two-seat IV-As, each with two 7200kg (15,873lb)st with afterburning SNECMA Atar 9K-50 turbojets, performed France's nuclear deterrent role until land and submarine-based missiles took over, thereafter becoming low-level tactical strike aircraft. Today the French Air Force operates 34 Mirage IV-As, each carrying a nuclear weapon recessed into the under-fuselage, or 16 1000lb bombs, or four Martel missiles. Maximum speed is 2340km/h (1454mph) and tactical radius 1240km (770 miles). Four more are used for training, and six bombers and four reconnaissance conversions are in reserve, the latter carrying the associated equipment for its new role in a large pod.

What future has the bomber? There is no doubt that the bomber of the 1980s is a vastly expensive aircraft, probably only affordable in any quantity to the 'superpowers.' It is more vulnerable to destruction than a submarine in the strategic role, but more versatile, allowing its use in limited and major conflicts and giving strategists the choice at any stage of carrying conventional or nuclear weapons. Has the bomber a future? Only time will tell.

Main picture: The Mirage IV-A supersonic strategic bomber (left) stands beside other Dassault-Breguet combat aircraft in the latter 1960s.

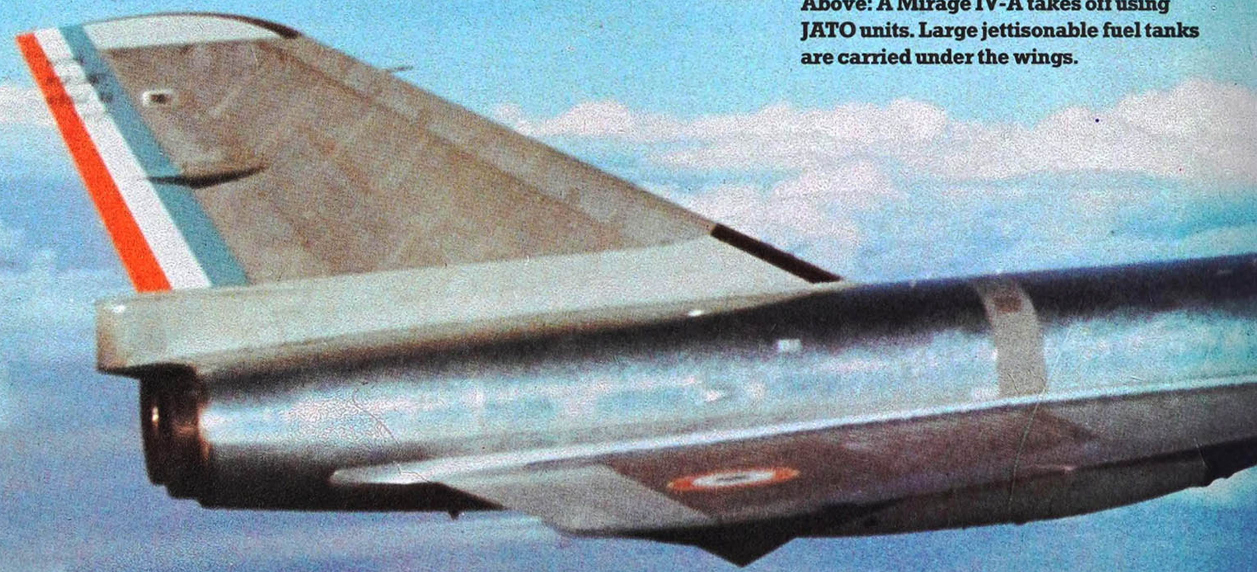


In this photograph the TSR 2 has its undercarriage lowered. The all-moving vertical tail surface and horizontal 'tailerons' for pitch and roll control are prominent.

The TSR 2 made its last flight on 31 March 1965. Here the aircraft is seen on display at Cranfield in 1967.

Britain's only supersonic attack bomber, the TSR 2, in level flight.

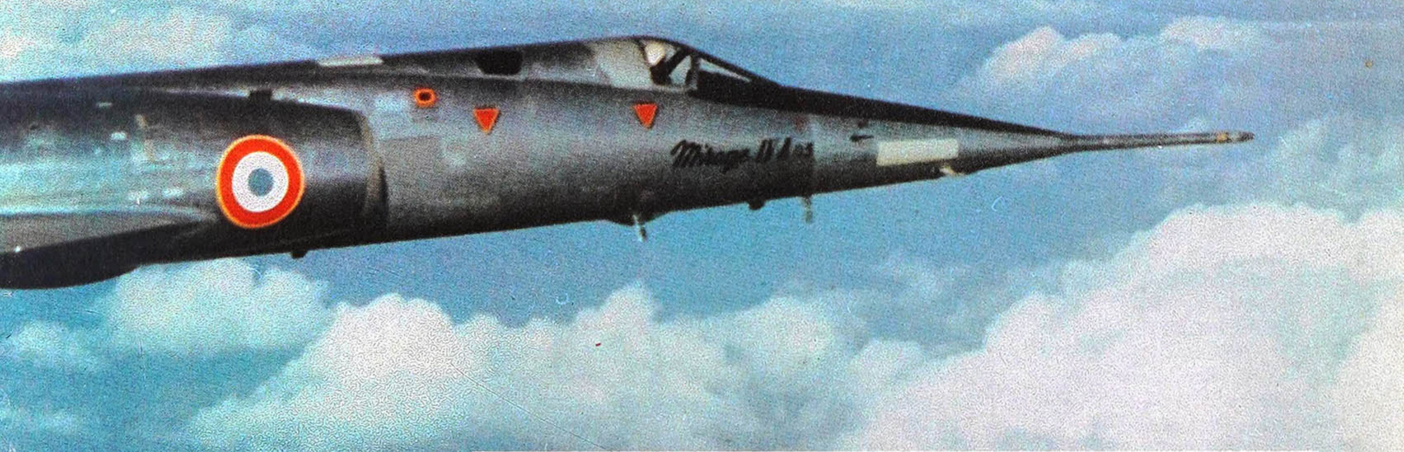
Above: A Mirage IV-A takes off using JATO units. Large jettisonable fuel tanks are carried under the wings.



A Mirage IV-A takes on fuel from a French Air Force Boeing C-135F tanker.

The Mirage IV-A as it now appears, in full camouflage for low-level missions.

This photograph of a Mirage IV-A in level flight shows the nuclear weapon semi-recessed under the fuselage.



The crew of a Vulcan B.Mk 2 leave their aircraft.

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ACKNOWLEDGMENTS

The photographs are from the author's collection except as listed below:

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Dennis Hughes: 42-3, 110-1, 132

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Michael J.H. Taylor is one of the most popular authors of aviation and related books. During the past fourteen years of full-time writing he has had more than thirty books published. He was the originator, editor and major compiler of the well-known five-volume *Jane's Encyclopedia of Aviation*. The youngest of the team of writers producing annual editions of *Jane's All the World's Aircraft*, he is responsible for the large section covering home-built aircraft. Michael Taylor's books have appeared in several foreign language editions.

Front cover: The Rockwell B-1 cancelled by President Carter and revived by President Reagan as the B-1B.

Back cover: The Convair B-58 Hustler.

ISBN 0 86124 122 3
Printed in Hong Kong